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Taking curriculum seriously

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Curriculum is all about power. Decisions about what knowledge to teach are an exercise of power and therefore a weighty ethical responsibility. What we choose to teach confers or denies power. To say that pupils should learn 'the best that has been thought and said' is never adequate. Start the conversation, and questions abound: 'Whose knowledge?'; 'Who decides on "best"?'.

Such questions reflect concern about whether schooling reproduces inequalities or interrupts them. Such questions matter. But reducing knowledge to voice will not get us far either. The contentious questions – Which works of literature? Which historical stories? Which art? – cannot be resolved by some optimal blend of diversity, some nirvana of neutrality, as though distribution across the sources of knowledge or types of knower will settle things. No matter how redemptive of former injustice, no holy grail of content selection will be reached.

Nor does adding in preparation for the 21st century help. How can we decide what is relevant to the ever-shifting 'now'? Worse, relevance quickly merges ›

with *perceptions* of relevance and, before we know it, content is chosen for being engaging or deemed 'relevant' by the pupil. Then we have completely lost our moorings. At that point, we lose touch with the duty of including the next generation in a shared language of abstract concepts, in common tools for precise thought, in the possibility of objective knowledge underlying them and in the possibility of citizens appraising it. These things serve the rationalised sensibility on which participation in a democratic society depends.

Appeal to knowledge *and* skills is no corrective either. These terms invoke such diverse assumptions that discussions end up at cross purposes. And to suggest that knowledge is less important than skills is to ignore the way in which our knowledge changes us, including our curiosity and capacity for new knowledge.

As educators, we need something more coherent concerning the character of knowledge – its structure, its origin, its status as a set of truth claims (such as their revisability) and the relationship of teachers and pupils to that knowledge. How, how far and when can teachers or pupils participate in challenging or reaching those truth claims? In which subjects and under what circumstances must they just accept them (for now) as givens?

How can a senior school leader tackle these questions? School leaders need practical solutions; few have time to swallow philosophical tomes. Yet to shy away from big ideas is always a false saving. And intellectual resources exist that are rigorous, accessible and useful. First, we have longstanding traditions of practice and debate within subject communities concerning ways of teaching the structure, status and origin of knowledge. Second, a relatively recent research programme arising from the sociology of knowledge advances the idea of 'powerful knowledge'. In this article, I will reflect briefly on just one theme emerging from the first, which is further illuminated by the second, namely the curricular distinction between substantive and disciplinary knowledge.

Substantive and disciplinary knowledge

Substantive knowledge is the content that teachers teach as established fact – whether common convention, concept or warranted account of reality. You might want pupils to know of crotchets, percentages, the Treaty of Waitangi, Debussy or prokaryotic cells. In calling this 'substantive', we are treating the material presented as givens.

Disciplinary knowledge, by contrast, is a curricular term for what pupils learn about how that knowledge was established, its degree of certainty and how it continues to be revised by scholars, artists or professional practice. It is that part of the subject where pupils understand each discipline as a tradition of enquiry with its own distinctive pursuit of truth. For each subject is just that: a product and an account of an ongoing truth quest, whether through empirical testing in science, argumentation in philosophy/history, logic in mathematics or beauty in the arts. It describes that part of the curriculum where pupils learn about the conditions under which valid claims can be made, and associated conventions such as what constitutes evidence or argument in that subject.

In those subjects where content choices are potentially infinite and selections must be made, it is through due attention to the disciplinary dimension that pupils know that *what I teach is not all that there is*. In those subjects where truth is sought through argumentation, pupils learn that even the selection and juxtaposition of two facts in a narrative amount to an interpretation, and that interpretation can be conducted responsibly or irresponsibly, but never definitively. A successful history, geography, RE or literature curriculum, in which the disciplinary was visible, will leave pupils absolutely clear that *even the curriculum itself*, as they received it, was one such selection, and must not be confused with the whole domain.

This substantive–disciplinary distinction works to differing extents and in very different ways across subjects. The disciplinary dimension is barely relevant, for example, in school-level modern languages. Moreover, *how* it gains expression in a school curriculum varies widely. In history, pupils encounter historical scholarship in order to learn how historians participate in a social process of claim and counter-claim. But they can't read scholarship without being drawn into the argument themselves. The date of the Treaty of Versailles is a given. Many events before and after the Treaty of Versailles are givens. But attributions of cause, consequence or significance to the Treaty of Versailles are *not* givens. The humblest of Year 7 history essays is elementary training in argumentation and produces legitimately different conclusions. Moreover, teacher-led, subject-specific research traditions have explored multiple ways of doing

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this well by blending secure substantive with rich disciplinary knowledge so as to refine pupils' appreciation and practice of historical argument (e.g. Foster, 2013).

Is it the same in science? Not quite. The substantive and disciplinary distinction definitely holds. Pupils study scientific methods, understand degrees of certainty, conduct investigations. But in terms of pupils' relationship to those processes and conclusions, there are differences. At school level, conclusions are not normally 'up for grabs' by pupils in quite the way they are in philosophy, literature or history, where argumentation itself is the method. In other words, each school subject stands in a slightly different temporal relationship to its real-world cognate of scholarly and professional knowledge production.

Therefore, when schools talk about pupils 'being' artists, historians or scientists, they are rarely talking about the same thing across subjects. In some subjects, we see frequent knowledge production processes (composing and creating; arguing and judging). In others, even those full of practising and doing within subject skills, the balance tilts towards knowledge reproduction, with less open-ended interpretation (a reason to avoid conflating 'disciplinary' with 'skills'). This doesn't mean that disciplinary knowledge is less important where less is 'up for grabs'. It may just mean that pupils (for now) are learning more about how *others* have established truth claims. Even for a textbook or teacher to state, '*Scholars are unsure* whether trade in seventh-century Arabia…' is to show disciplinary attentiveness by modelling responsible claims.

All this matters in whole-school leadership. 'Substantive' and 'disciplinary' are illuminating categories not only for understanding curriculum but also for grasping the implications of curriculum for teaching and assessment. Regarding teaching, they help senior leaders to interpret teaching activities in the light of an object. Before one can apply research into the efficacy of (say) pair/group discussion, one needs to establish *what* is being taught. Failure to do this has caused untold problems. A world of difference exists between a paired discussion designed to practise a facet of open argument derived from a particular discipline and a paired discussion designed for learning substantive content. In one, the dialogue teaches a disciplinary process; in the other, the rationale is constructivist pedagogy. They cannot be appraised in the same way. Regarding assessment, an understanding of substantive and disciplinary would have seen senior leaders questioning the use of level descriptions for formative assessment years earlier than actually happened. Each subject has its own pattern and interplay between learning substantive content and engaging with its origins or processes. The practice of treating *progress* as mini-versions of level descriptions and GCSE mark schemes has dangerously distorted subject structures and journeys.

The expression 'knowledge-rich' curriculum is normally associated only with substantive knowledge. This is understandable given that we're emerging from an era in which mastering content was sidelined, even demonised, and given the attention now paid to research

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on the relationship between academic content knowledge and reading, on the vocabulary gap between advantaged and disadvantaged and on the role of knowledge in making subsequent learning possible (Willingham, 2017). But we cannot neglect the disciplinary dimension. This is achievable even in the primary phase. Our Year 4 pupils' questions show that they are fascinated by Mendeleev's cleverness in making the periodic table open and revisable, by van Leeuwenhoek's worries about the Royal Society taking his microscope seriously, by the questions that geographers ask about borders and boundaries.

Powerful knowledge

The categories 'substantive' and 'disciplinary' are merely one cross-section of useful curriculum analysis but they are foundational. Their significance is further illuminated by a body of research within the sociology of knowledge that tackles education's knowledge question within a progressive agenda for social justice (Rata, 2016; Young, 2008). Associated with the concept of 'powerful knowledge', these theorists challenge the view that academic knowledge necessarily perpetuates disadvantage by remaining the preserve of the powerful forces that created it. Drawing on Durkheim, they argue that knowledge developed by academics in intellectual communities becomes independent of those socio-historical origins through its abstract and generalising tendencies. Because this specialised knowledge is not acquired or produced informally in everyday experience, entitlement to it through curriculum is vital (Young and Muller, 2016).

Not only does this knowledge offer the language of abstract concepts, but these precise concepts also become tools with which to imagine change. They enable humans to theorise possibility and think the un-thought (Wheelahan, 2010). To achieve this, a curriculum must enact processes of 'epistemic ascent' (Winch, 2013), by which concepts already understood by students are brought into new relations of abstraction and generality, giving the student yet more power to challenge, rethink and create. McPhail (2014) illustrates this with music. He explains how without epistemic understanding, pupils are restricted to subjective experience of music. Discussing the complex relationships between music's subjective and objective dimensions, McPhail shows how teachers can integrate students' ownership of music's affective power with access to knowledge fundamental to the conversations of the discipline.

Powerful knowledge theorists emphasise that specialised knowledge is emergent, provisional and revisable through continuing social processes such as scholarly research and critique

While collaborating in building a trust-wide, knowledge-rich curriculum, we have found it useful to reflect on this body of work, not only regarding the power inherent in the abstractions of substantive knowledge, but also regarding each subject's disciplinary dimension. Powerful knowledge theorists emphasise that specialised knowledge is emergent, provisional and revisable through continuing social processes such as scholarly research and critique. For pupils to learn how knowledge is formed and changed distinguishes a knowledge-rich curriculum grounded in 'powerful knowledge' from one merely ossifying a canon. In a stark prediction of three futures, Young and Muller (2016) contrast a Future 1 in which knowledge is fixed and tied to the social context that produced it, and a Future 3 whose radical potential harnesses the fertile, generative qualities of knowledge to give all citizens access to intellectual tools for rational change.

This article scratches the surface of debates that school and system leaders cannot ignore. Given its implications for democracy, curriculum is a serious business. We must engage with its provenance and properties.

REFERENCES

Foster R (2013) The more things change, the more they stay the same: Developing students' thinking about historical change and continuity. *Teaching History* 151: 8–17.

McPhail G (2014) Pathways to powerful knowledge: A case for music. In: Barratt B and Rata E (eds) *Knowledge and the Future of Curriculum: International Studies in Social Realism.* Houndmills: Palgrave Macmillan, pp. 123–135.

Rata E (2016) A pedagogy of conceptual progression and the case for academic knowledge. *British Educational Research Journal* 42(1): 168–184.

Wheelahan L (2010) *Why Knowledge Matters in the Curriculum.* Abingdon: Routledge.

Willingham D (2017) *The Reading Mind.* San Francisco: Jossey Bass.

Winch C (2013) Curriculum design and epistemic ascent. *Journal of Philosophy of Education* 47(1): 128–146.

Young M (2008) *Bringing Knowledge Back In: From Social Constructivism to Social Realism.* London: Routledge.

Young M and Muller J (2016) *Curriculum and the Specialisation of Knowledge.* London: Routledge.

CASE STUDY

How can formative assessment work for both learners and teachers?

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'Imagine what a difference it would make if children knew what they were good at and what they had to do to improve.' With these stirring words, our trainer extolled the benefits of feedback. Teachers should make sure students were absolutely clear about where their work needed further crafting and provide them with time to do this. It was, and still is, a compelling vision. So what went wrong?

What went wrong was that feedback was interpreted as meaning marking. And not just any old marking – dialogic marking. Fast forward 10 years and schools were marking within an inch of their lives. The toll on teachers was terrible; there just weren't enough hours in the day to get the marking done. Yet this toil had dubious actual impact on learning (Elliott et al., 2016).

So it was a surprise when I discovered that Dylan Wiliam, prime advocate of 'feedback', has little to say about marking per se, let alone labour-intensive dialogic marking. He describes feedback as *anything* that lets the student *or the teacher* know how well the learning is going. It might be something as fleeting as student facial expressions (2016). The term feedback, Wiliam explains, is borrowed from the engineering expression 'feedback loop' (2011). For example, a thermostat regulates temperature by measuring the current temperature, comparing this with the desired temperature and then doing something (activating a heating or cooling mechanism) to bring the current state in line with the desired state. The important part in all this is *the response to the alert of a discrepancy*. Without a mechanism to close the gap between the current and the desired state, feedback about the discrepancy is useless. In an educational context, the same applies. Feedback needs to be not only accurate in its diagnosis of what is wrong, but also helpful in enabling the learner to put it right.

Closing the feedback loop

Wiliam's work on feedback has been interpreted as involving written comments intended to give the learner information on how to improve their work. Yet often the gap between where the learner is now and where the teacher wants the learner to be is too big to be bridged by a single comment. Wiliam uses the example of a student commenting on his science assignment. The teacher had written: 'You need to be more systematic in planning your scientific inquiries.' The student retorted: 'If I knew how to be more systematic, I would have been more systematic the first time' (Wiliam, 2011). The written comment, intended to close that feedback loop, is nothing more than a diagnosis of the problem. It's like a red light on the central heating; it tells us something is wrong, it might even identify what the fault is, but it does not miraculously give us the knowledge of how to fix the problem. For that we need more teaching. The next step for this science student was another lesson, focused on what he couldn't yet do. Feedback needs to effect change and cannot be reduced to a simple formula.

Another problem is that sometimes marking is so easy to action that the learner doesn't have to think at all. As long as they mindlessly follow the teacher's instruction, then the work will 'improve'. Never mind that the student hasn't learnt anything new so the 'fault' is likely to recur. It's not just about closing the feedback loop, it is about closing it so that it stays closed. If we identify every missing full stop, every place value error for students, then we shouldn't be surprised if they carry on omitting full stops and putting digits in the wrong columns.

Marking policy and effective feedback

Feedback is a powerful way of improving learning, but it has to be used thoughtfully. Our previous marking policy conflated feedback with marking and outlined a one-size-fits-all procedure intended to fit every subject. It assumed that a 10-minute 'pupil response' session at the start of every lesson was always the best way to ensure lasting improvements. Feedback was reduced to a simplistic formula. Sometimes marking was so specific it spoon-fed students, removing any actual learning. For example, our marking code identified all missing full stops with a triangle. Students did not have to reread their work to find where the missing full stops should go. They merely found a triangle and inserted a full stop. This was lots of work for the teacher and hardly any for the student, whereas Wiliam states that 'feedback should be more work for the recipient than the donor' (2011).

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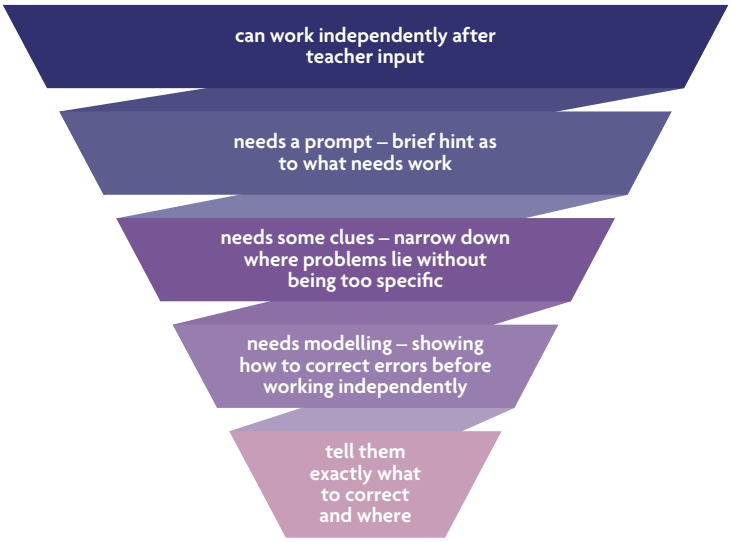
FIGURE 1:
THE STRATEGIC MINIMAL MARKING TRIANGLE



Extract from St Matthias School Feedback and Marking Policy:
Start out with the assumption that all children can work independently given prior input and only increase the amount of intervention if the pupil really can't get on without it. Give children take-up time; let them struggle for a bit, but above all, make sure they are the ones doing the hard work, not you.

Our new policy, based on Wiliam's work, puts learners to work. Instead of marking, the teacher plans the next lesson around feedback they have gleaned from reading the students' work. Strengths and weaknesses are highlighted with the whole class, with new teaching addressing any gaps that need more explanation. Students then have a substantial amount of time – often most of the lesson – to go back and hone their work in the light of this input. This requires effort on their part. They have to locate their own errors and think of their own improvements. Now, 'the next step is the next lesson'. We therefore cover less, but students learn more. And teachers have their lives back.

REFERENCES

Elliott V, Baird J, Hopfenbeck, T N, Ingram J, Thompson I, Usher N, Zantout, M, Richardson J and Coleman R (2016) *A Marked Improvement? A Review of the Evidence on Written Marking*. Oxford: Education Endowment Foundation.

Wiliam D (2011) *Embedded Formative Assessment*. Bloomington, IN: Solution Tree Press.

Wiliam D (2016) Formative assessment. In: *Leadership for Teacher Learning: Creating a Culture Where All Teachers Improve so that Students Succeed*. West Palm Beach, FL: Learning Science International.

Guiding student improvement without individual feedback

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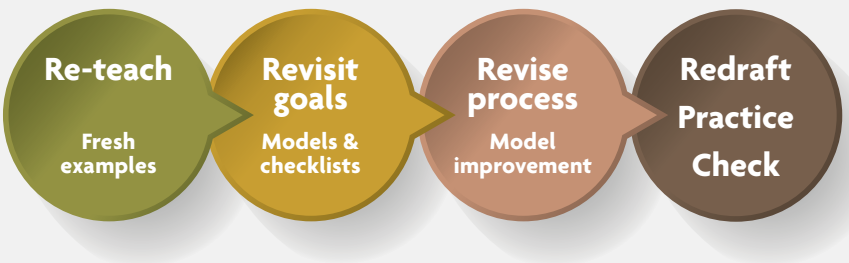
- **Feedback seems extremely powerful.** It is 'among the most common features of successful teaching and learning' with an average effect size of 0.79, 'twice the average effect of all other schooling effects' (Hattie, 2012: pp.115–116). Such meta-analyses are problematic (see, for example, Wiliam, 2016) and more recent reviews have offered lower effect sizes, but the overall picture is clear: 'Good feedback can significantly improve learning processes and outcomes' (Shute, 2008). Anders Ericsson emphasises the importance of feedback and guided improvement in his work on expert performance: 'Deliberate practice involves feedback and modification of efforts in response to that feedback' (Ericsson and Pool, 2016: p.99).
- **Providing effective feedback is problematic, however.** 'While feedback is among the most powerful moderators of learning, its effects are among the most variable' (Hattie, 2012: p.115). Providing feedback successfully is a real challenge: 'Get it wrong, and students give up, reject the feedback, or choose an easier goal' (Wiliam, 2011: p.119). This is illustrated most vividly in Kluger and DeNisi's meta-analysis (1996), which found that studies of feedback showed an average effect size of 0.41, but that more than 38 per cent had negative effects.
- **Providing effective feedback to individual students is problematic for practical reasons too.** Marking is the most common way to provide individual feedback, but there is limited evidence of its effectiveness (Elliott et al., 2016) and it takes an inordinate amount of teachers' time (Gibson et al., 2015). We may limit our marking in favour of verbal feedback, but reaching every student and giving clear verbal feedback may prove challenging during busy lessons. Once we've assessed students' work, there are different ways in which we can guide improvement without giving individual feedback.

These approaches (see also **Figure 1**) could be combined with one another, or with individual feedback – but each might also prove effective on its own:

1. Re-teaching

Re-teaching allows us to challenge common misconceptions or knowledge gaps collectively and efficiently. We might reiterate definitions or offer mnemonics to support students with declarative knowledge; or we might offer examples, counterexamples and big pictures to support conceptual knowledge (Shute, 2008). While we could repeat our initial teaching, fresh images, examples and metaphors are likely to prove more useful: students who struggled to add using a number line may do better with counters; those confused by their reading about the American constitution may benefit from studying the court cases around President Trump's 2017 travel ban. Students who 'got it' last lesson need not get bored: they'll have forgotten aspects of the lesson and can also offer some of the explanations. Reteaching seems the simplest and most efficient way to approach knowledge gaps and misconceptions without giving individual feedback.

FIGURE 1:
PROVIDING EFFECTIVE FEEDBACK



2. Revisiting goals

Closing the gap between students' performances and goals may require more (or clearer) knowledge; it may also require clearer goals. Just as we may revisit what we taught students, we may also revisit the models we offered, or provide fresh ones; students can now compare their efforts with the model and better understand where the gap lies. Revisiting checklists may help students identify missing features of their work: punctuation, point sentences or balanced equations. Asking students to revisit the goals through examining one another's work might work, but could prove unpredictable – the teacher's choice of a model in advance is likely to prove more productive. Revisiting goals allows students both to improve the work at hand and to understand better what good work looks like in the subject.

3. Revising the process

We may also help students revise how they can change their work to meet these goals. We can do this by modelling the process of improvement – providing demonstrations and worked examples to show what students can do to their work (Shute, 2008). Taking a student's answer, or a weak example of our own, we could model rewriting a paragraph or solution on the board. By asking students to 'suggest another way we could put this, even more clearly' or 'remove unnecessary words', we can model both the kind of sentences or components, and the kind of changes which create an excellent product. Demonstrating how we improve work both shares a process students can follow and further clarifies our goals by showing the choices we make and the difference between a good and a beautiful sentence.

4) More practice

Knowing exactly where students are at is important. It doesn't mean we have to intervene immediately: students may benefit from further practice, perhaps even without error correction. I have written about times when lower student performance can lead to greater learning (Fletcher-Wood, 2017); Josh Goodrich noted, as a response, that teachers skilled in formative assessment can use this to keep tight control of student learning, mistakes and misconceptions. The result can be that students never get the chance to struggle, as teachers address misconceptions immediately without allowing students to do the thinking which may lead to longer-term learning. This is supported by Kluger and DeNisi's (1996) observation that feedback 'may reduce the cognitive effort involved in task performance' and so be 'detrimental in the long run'. As Goodrich observes, if we don't allow students to struggle, although it can appear that students are doing well, this may harm their longer-term retention. This is not an easy message to convey – particularly to observers – but it is an important one: rapid feedback, particularly after students have acquired the knowledge they require, may diminish learning; sometimes, more practice is the best thing for students.

Conclusion

Each of these approaches might usefully be combined with individual feedback: teachers often revisit what students are aiming for before asking them to act on feedback, for example. What I'm wondering is whether we can achieve similar results (better work, better learning) without individual feedback. I've not seen any study comparing delivery of the same feedback to a group and an individual. One possible disadvantage would be students treating group activities as irrelevant to them (through over- or under-confidence). The responses we ask of students after using the techniques above – such as redrafting, further practice or another check for understanding – are therefore particularly important. Conversely, these approaches allow us to provide far clearer and more detailed guidance than we could possibly provide each individual: we can plan one good five-minute explanation, rather than attempting to convey these ideas in 30 individual comments. Of the many ways to guide improvement, perhaps these approaches can save us the most time while also benefiting students.

This is an extract from *Responsive Teaching: The Classroom Teacher's Guide to Formative Assessment*, to be published in 2018.

FURTHER READING

More on unit plans, including a downloadable template, can be found on the author's blog here: https://improvingteaching.co.uk/2017/04/23/better-planning-better-teaching-better-learning-a-template

There are some great examples of how to expand student vocabulary in maths lessons in Doug Lemov's blog: http://teachlikeachampion.com/blog/julia-addeo-improves-student-thinking-improving-student-vocabulary

REFERENCES

Elliott V, Baird J, Hopfenbeck T, Ingram J, Thompson I, Usher N, Zantout M, Richardson J and Coleman R (2016) *A Marked Improvement? A Review of the Evidence on Written Marking*. Oxford: Education Endowment Foundation.

Ericsson A and Pool R (2016) *Peak: Secrets from the New Science of Expertise*. London: Bodley Head.

Fletcher-Wood H (2017) Is formative assessment fatally flawed? In: Improving Teaching. Available at: https://improvingteaching.co.uk/2017/03/26/formative-assessment-flawed-confusing-learning-performance/#comment-766 (accessed 21 August 2017).

Gibson S, Oliver L and Dennison M (2015) *Workload Challenge: Analysis of Teacher Consultation Responses*. London: Department for Education.

Hattie J (2012) *Visible Learning for Teachers: Maximizing Impact on Learning*. Abingdon: Routledge.

Kluger A and DeNisi A (1996) The effects of feedback interventions on performance: A historical review, a meta-analysis, and a preliminary feedback intervention theory. *Psychological Bulletin* 119(2): 254–284.

Sadler D (1989) Formative assessment and the design of instructional systems. *Instructional Science* 18(2): 119–144.

Shute V (2008) Focus on formative feedback. *Review of Educational Research* 78(1): 153–189.

Wiliam D (2011) *Embedded Formative Assessment*. Bloomington, IN: Solution Tree.

Wiliam D (2016) *Leadership for Teacher Learning: Creating a Culture Where All Teachers Improve So That All Students Succeed*. West Palm Beach, FL: Learning Sciences International.

ISTOCK

Skilful questioning: The beating heart of good pedagogy

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The issue that teachers face

Questions are an integral part of classroom life and essential to every teacher's pedagogical repertoire. They are also one of the elements of effective formative assessment (Black et al., 2003). Questioning serves many purposes: it engages students in the learning process and provides opportunities for students to ask questions themselves. It challenges levels of thinking and informs whether students are ready to progress with their learning. Questions that probe for deeper meaning foster critical thinking skills and higher-order capabilities such as problem solving, and encourage the types of flexible learners and critical thinkers needed in the 21st century.

Questioning is a crucial pedagogical skill, but one that requires practised knowledge (Cavanaugh and Warwick, 2001). Paramore (2017) identifies an imbalance of questions often found in teaching, saying there is a dominance of teacher talk and an over-reliance on closed questions, providing only limited assessment for learning (AfL) information for a teacher. The issue then is how classroom questioning strategies can become more effective, as evidence suggests that teachers ask too many questions and too many of these questions are low level.

What the research says

The value of classroom questioning is well documented. Research tends to focus on the relationship between teachers' questions and student achievement; here are some of the important messages.

Types of questions used

Too often, questions from teachers are organisational, such as 'What do we always put at the top of our page to begin with?' or instructional in nature, such as 'Who can tell me what an adjective is?' and fail to develop deep learning. Wragg's early study (1993) found teachers commonly use three types of question:

1. Management-related, e.g. 'Has everyone finished this piece of work now?'
2. Information recall-related, e.g. 'How many sides does a quadrilateral have?'
3. Higher-order questions, e.g. 'What evidence do you have for saying that?'

Questioning is a crucial pedagogical skill, but one that requires practised knowledge

In Wragg's study, 57 per cent of questions were management related, 37 per cent required information recall and only 8 per cent challenged higher-order thinking.

Closed or convergent questions have low cognitive involvement and result in limited answers such as 'Yes' or 'No'. Open or divergent questions encourage greater expansion in answers and promote better classroom dialogue (Tofade, Elsner and Haines, 2013). Closed questions are still important, however, and help assist in knowledge retrieval; but proceed with caution here, as the inevitable one-word student answers limit classroom dialogue resulting in what Alexander called 'cognitively restricting rituals' (2006: p.14). Lower-attaining students benefit from closed questions, allowing them greater accuracy of response which in turn breeds encouragement, while higher-attaining students respond better to more challenging questions (Woolfolk, 2008). In order to maximise AfL in lessons, use different types of questions but limit the procedural and emphasise questions that centre on learning, and differentiate them to maximise AfL.

Timing

Student wait time (giving a brief period of time for students to think or reflect before answering) has a positive effect on learning. Brooks and Brooks (2001) found that a rapid-fire questioning approach fails to provide teachers with accurate information about student understanding. Typically, the time between asking a question and a student's response is about one second. Cohen et al. (2004) recommend wait times of three to five seconds for closed questions and up to 15 seconds for open-ended questions.

Cognitive levels

Complex questions promote complex thinking, argue researchers Degener ›

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and Berne (2016). But is it really that simple? There is a lack of consensus in the literature. Some researchers have found higher-cognitive questions superior to lower ones while others have not. In general, the level of teachers' questions is low. Around 60 per cent of questions expect only factual information from students (Lee and Kinzie, 2012). Samson et al. (1987) found that higher-cognitive questioning strategies have a positive effect on learning, but this was not as large as has been previously suggested. Simply asking higher-cognitive questions does not necessarily produce higher-cognitive responses from students.

On balance, low-level questioning aimed at recall and fundamental-level comprehension will plateau classroom learning quickly. Higher-level questions can produce deeper learning and thinking, but a balance needs to be struck. Both have a place and a mixture of questions is recommended.

Effective approaches

Over the years, classification taxonomies have been developed to guide teacher questioning (see Krathwohl (1964); Wilen (1986) and Morgan and Saxton (1991) as early examples). Hannel and Hannel's 'highly effective questioning method' (2005) shows how teacher questions promote student engagement, and an interesting approach is the 'sequences of teacher and student questions' (Dekker-Groen, 2015). In literacy, Degener and Berne (2016) devised their six-level 'continuum of questioning complexity' to offer increased challenge at each cognitive level. Shirley Clarke's website (www.shirleyclarke-education.org) has a wide range of practical resources on AfL and proven questioning strategies.

Perhaps the most well-known questioning framework is Bloom's cognitive taxonomy (1956), later revised by Anderson and Krathwohl (2001). In this six-level hierarchy, lower-order questions gauge comprehension; medium-level gauge knowledge application, and higher-order questioning elicits synthesis, analysis and evaluation.

Knowledge
'Can you remember...?'
Comprehension
'Tell me how this works...'
Application
'Where else have you seen this pattern?
Analysis
'Explain to me what is happening here?'
Synthesis
'What conclusions can you draw from this?'
Evaluation
'Can you measure how effective this is?'

Trigger words are an effective way to formulate questions, as shown in **Table 1**.

TABLE 1:
TRIGGER WORDS LINKED TO BLOOM'S TAXONOMY

LEVEL	TRIGGER WORDS
Knowledge	what, who, when, name, list, define, show, identify
Comprehension	compare, distinguish, illustrate, tell, predict, explain
Application	apply, select, solve, choose, consider, connect, plan
Analysis	analyse, classify, relate, support, compare/contrast
Synthesis	propose, formulate, draw together, invent
Evaluation	judge, measure, defend, evaluate, decide, assess

Ideas to try in the classroom

There are many questioning tactics to choose from to promote learning and provide excellent formative assessment information:

1. **No hands up.** Anyone can answer, which avoids the same few students answering questions.
2. **In the hot seat.** Students take it in turns to sit in the 'hot seat' and answer questions.
3. **Ask the expert.** The teacher puts questions to a student on a given topic, extending this to encourage

other students to ask questions.

4. **Ask the classroom.** The teacher displays a number of written questions to stimulate thinking about pictures or objects in the classroom.

5. **Think-pair-share.** Allows time to share ideas with a partner and respond to a posed question.

6. **Phone a friend.** A useful strategy in which a student nominates another to answer the teacher's question. The first student also provides an answer.

7. **Eavesdropping.** When groups are working, the teacher circulates around the classroom and poses questions to groups based on what is heard in their discussions.

8. **Question box.** An actual box has a series of questions in it devised by the teacher. Time is set aside at the end of a week to choose some to discuss as a class.

9. **Here is the answer, what is the question?** Deliberately back to front to encourage out-of-the-box thinking.

10. **More than me.** The teacher asks a student a question and deliberately cuts short the answer to involve another student to build on this answer.

Questions are among the most powerful teaching tools we have

Things to take into account

> *'It is better to have a classroom full of unanswered questions than unanswered answers'* (Morgan and Saxton, 1991).

Good questions develop discussion and invite exploration. Poor questions can stifle and put undue pressure on students. Using a variety of question types to inform your assessment can transform your classroom into a 'questioning classroom'. A classroom ethos and organisation with enquiry at its heart is an effective one, where purposeful talk dominates and teachers ask fewer questions. Dialogic teaching (Alexander, 2017) uses skilled questions to extend thinking where answers to teachers' questions are built on rather than merely received. Dialogue allows a teacher to respond to students' answers and if necessary re-orientate them. Exchanges chain together, feedback from questions leads thinking forward and students' answers are extended. Questions are among the most powerful teaching tools we have and adopting best practices will significantly enhance the quality of teaching and learning.

Questions to reflect on/discuss

1. Is my classroom a 'questioning classroom'?
2. Does talk permeate my teaching and learning approach?
3. What types of questions and how many questions do I typically ask in my teaching?
4. Do the questions I ask target higher-order thinking and raise the cognitive stakes? Is this true of my teaching across all subjects?

FURTHER READING

Excellent website with many resources to embed AfL and effective questioning in classrooms: Available at www.shirleyclarke-education.org.

Chapter 2, Questioning to learn, is very readable: Fisher R (2005) *Teaching Children to Learn*. Cheltenham: Nelson Thornes.

Practical and clear overview of Bloom's taxonomy: West Lothian Council Educational Psychology Service. Questioning. Raising Attainment sheet 1. Available at: www.westlothian.gov.uk/education.

REFERENCES

Alexander RJ (2006) *Towards Dialogic teaching: rethinking classroom talk*. 3rd ed. Cambridge: Dialogos.

Alexander RJ (2017) *Towards Dialogic Teaching: rethinking classroom talk*. 5th ed. Cambridge: Dialogos.

Anderson LW, Krathwohl DR, Airasian PW, Cruikshank KA, et al. (2001) *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives*. New York: Longman.

Black P, Harrison C, Lee C, Marshall B and Wiliam D (2003) *Assessment for Learning: Putting it into Practice*. Maidenhead: Open University Press.

Bloom BS (ed.) (1956) *Taxonomy of Educational Objectives: The Classification of Educational Goals, Handbook I: Cognitive Domain*. New York: David McKay Company, Inc.

Brooks, JG and Brooks MG (2001) Becoming a constructivist teacher. In: Costa: AL (ed.), *Developing Minds: A Resource Book for Teaching Thinking* (pp.150–157). Alexandria, VA: Association for Supervision and Curriculum Development.

Cavanaugh MP and Warwick C (2001) Questioning is an art. *Language Arts Journal of Michigan* 17 (2): 35–38.

Cohen L, Manion L, and Morrison K (2004) *A Guide to Teaching Practice*. London: Routledge.

Degener S and Berne J (2016) Complex questions promote complex thinking. *The Reading Teacher* 70 (5): 595–599. International Literacy Association.

Dekker-Groen A, Van der Schaaf M and Stokking K (2015) Teachers' questions and responses during teacher-student feedback dialogues. *Scandinavian Journal of Educational Research* 59(2).

Hannel GI and Hannel L (2005) *Highly effective questioning* 4th ed. Phoenix AZ: Hannel Educational Consulting.

Krathwohl DR, Bloom BS and Masia BB (eds) (1964) *Taxonomy of educational objectives: Handbook II: The affective domain*. New York: McKay.

Lee Y and Kinzie MB (2012) Teacher question and student response with regard to cognition and language use. *Instructional Science: An International Journal of the Learning Sciences* 40(6): 857–874.

Morgan N and Saxton J (1991) *Teaching Questioning and Learning*. New York: Routledge.

Paramore J (2017) Questioning to stimulate dialogue. In: Paige R, Lambert S and Geeson R (eds) *Building skills for Effective Primary Teaching*. London: Learning Matters.

Samson GK, Strykowski B, Weinstein T and Walberg HJ (1987) The effects of teacher questioning levels on student achievement. *The Journal of Educational Research* 80(5): 290–295.

Tofade TS, Elsner JL and Haines ST (2013) Best practice strategies for effective use of questions as a teaching tool. *American Journal of Pharmaceutical Education* 77 (7) Article 155.

Wilen WW (1986) *Questioning skills, for teachers*. Washington DC: National Education Association.

Woolfolk A, Hughes M and Walkup V (2008) *Psychology in Education*. Harlow: Pearson.

Wragg EC (1993) *Questioning in the Primary Classroom*. London: Routledge.

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Optimising learning using retrieval practice

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GETTY

Retrieval practice, or reconstructing knowledge by bringing it to mind from your memory, has been shown by numerous researchers to improve student learning (see Roediger et al., 2011). Saying that retrieval practice promotes learning in the classroom is all well and good, what does this actually mean for teachers who want to implement retrieval practice in their classrooms? Teachers might wonder how successful students need to be for retrieval to promote learning. How difficult should retrieval opportunities be? Does the format of retrieval practice matter? How should I time the questions within a lesson? Some of these things may matter, while others may not. In this article, we briefly describe retrieval practice as a learning strategy and then we review research addressing these questions to help teachers find the best ways to utilise retrieval practice in their classrooms.

Practising retrieval improves learning compared to rereading information (Roediger and Karpicke, 2006) – a strategy that many college students report using (for example, Hartwig and ›

Dunlosky, 2012). Retrieval practice can also improve learning compared to other study strategies thought to be beneficial, such as creating a concept map while reading (Karpicke and Blunt, 2011). Promoting retrieval practice in the classroom can simply involve giving students frequent tests or quizzes. In fact, the retrieval practice phenomenon was called *the testing effect* for much of the last century, but now is more commonly called retrieval practice because one can promote retrieval with activities other than tests or quizzes (for example, Karpicke, Blunt et al., 2014). Importantly, retrieval practice can help with both fact-based learning and meaningful learning and transfer (Butler, 2010; Carpenter, 2012; Jensen et al., 2014; Smith et al., 2016). Thus, retrieval practice is of significant value in educational settings, and research in live classrooms confirms that utilising retrieval practice improves student learning in multiple contexts. For example, a retrieval practice benefit has been shown for adult learners in college classrooms (Mayer et al., 2009) as well as for primary school classrooms with middle-school students (McDermott et al., 2014), among others.

How successful do students need to be during retrieval?

To gain the most benefit, students do need to successfully retrieve a certain amount of the information during retrieval practice. Imagine if a student just stared at a blank sheet of paper and could not remember anything about what they had just read; this would be unlikely to produce learning. Some research has shown that guessing even when you do not know the answer can lead to improvements in learning (Kornell et al., 2009). However, it would not be good for students to always guess and never really know.

Research we conducted with students aged nine to 10 years demonstrates the need for some success during retrieval (Karpicke, Blunt et al., 2014). We had children follow along as a research assistant read them a text that was selected from the school curriculum, so that it was at the appropriate level for the students. However, when the students were given a blank piece of paper to recall what they could remember, they were not able to recall very much. On average, the students only wrote down 9% of the information, with some children not being able to write anything. Unsurprisingly, the children performed very poorly on an assessment test four days after this learning activity. They remembered more in the control condition, during which the research assistant repeatedly read the text to them, which is the opposite pattern to that typically found in retrieval practice experiments.

We realised that these younger students needed guides in order to retrieve the information. In another experiment, we gave the children question maps with the topic of the text in the centre, and then a few prompts around the centre to guide recall. For example, one text was about clouds and one of the prompts was 'describe cumulus clouds (shape and colour)'. When students were first able to complete the map with the text in front of them, they were then much more successful at retrieving the information when they had to fill out the map without the text. This led to greater performance on a later assessment compared to the repeated reading control group.

However, this is not just about children and adult learners. If university students are not very successful during retrieval, they will not benefit as much either (Kang et al., 2007). Regardless of the student's age, some amount of success is necessary.

How difficult should the retrieval opportunities be?

While we want students to be able to retrieve some information, we also do not want retrieval to be too easy. A teacher could lead a student to successfully reproduce the information from a text by only presenting the information one tiny chunk at a time and then asking the student to retrieve just that little chunk of information. Repeating little chunks like this will likely lead to a high amount of information being produced, but it is still unlikely to produce durable learning. Students need to think back to a prior time when they learned information to reconstruct this information (Karpicke, Lehman et al., 2014), and some amount of difficulty is ideal during this process. The important thing is to balance retrieval difficulty and success. You do not want the retrieval to be so difficult

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that students fail to retrieve anything at all, but you do not want it to be so easy that they do not really have to think back and reproduce the information. Teachers will likely need to monitor difficulty and success, and adjust retrieval activities accordingly. For example, if students are very easily and quickly retrieving information and are retrieving almost everything, teachers might consider making the activity more difficult. If retrieval success is very low, such as below 50%, then providing prompts to help the students retrieve will likely be helpful. Teachers can also provide scaffolding to help their students achieve success initially, and then slowly make retrieval more difficult as the students become more comfortable with the material. Doing this has the added benefit of ensuring repeated retrieval, and continuing to retrieve information multiple times over a period of time is very beneficial to learning (Kapler et al., 2015).

Does the format of retrieval practice matter?

Two of the most extensively researched retrieval-practice formats are short-answer and multiple-choice questions. This is likely to be because these two types of questions are common for tests and quizzes in educational settings. But does it matter whether multiple-choice or short-answer quizzes are used?

There are obvious practical benefits to multiple-choice questions over short-answer questions. Multiple-choice questions are easier to administer and mark. This may mean for many teachers that multiple-choice quizzes could be given more frequently, since they are less time-consuming, and subsequently may mean increased retrieval opportunities for students in the classroom. Multiple-choice questions are also more likely to yield success during retrieval practice. However, short-answer questions are more difficult to answer, and the effort involved may lead to greater learning benefits (see Kang et al., 2007). Teachers can also create a hybrid format on the computer, where students first answer a question in a short-answer format and then advance to answer the same question posed as a multiple choice. This hybrid format combines the potential benefits of both, but does require each student to have access to a computer.

Thankfully, the exact format of the question may not much matter for learning. In a series of experiments, we (Smith and Karpicke, 2014) investigated the differences between short-answer, multiple-choice and hybrid formats. Students read a series of texts about different topics (for example, Venice) and then answered questions. The questions were either short-answer, multiple-choice or the hybrid format mentioned earlier. One group did not practise retrieval. All students were then given a sentence that contained the correct answer to each question as feedback. One week later, the students returned and took a short-answer test to assess learning. The results showed that, across all of the experiments, all of the retrieval practice formats increased learning compared to not practising retrieval. On the other hand, there were only negligible differences in later performance between different retrieval practice formats. More detail on this study and the results can be found at: http://www.learningscientists.org/blog/2016/3/18-1.

Recent research suggests that interspersing quiz questions throughout learning can reduce the interference that happens when we are trying to learn a lot of similar pieces of information in a row

Similarly, other researchers have found little to no difference between short-answer and multiple-choice quiz formats when feedback is given (for example, McDermott et al., 2014). Short-answer questions are more difficult, but multiple-choice questions lead to more success, and feedback is not always enough to make up for the success differences between these two. When multiple-choice questions are created to require students to actually think back about the answer rather than just relying on which answer looks familiar to them (see Little et al., 2012), multiple-choice questions can be just as effective at producing learning as short-answer questions.

How should I time the questions within a lesson?

Most of the research on implementing quizzing in the classroom with positive results has focused on quizzes that are given after the lecture (for example, Lyle and Crawford, 2011). However, one might rightfully wonder whether it is best to give these end-of-class quizzes, or might it be more effective to intersperse quizzes throughout a class? Recent research suggests that interspersing quiz questions throughout learning can reduce the interference that happens when we are trying to learn a lot of similar pieces of information in a row, such as long lists of words (Szpunar et al., 2008; Weinstein et al., 2014) or many face–name pairs (Weinstein et al., 2011). This research has also been applied to more educationally relevant information, such as video lectures (Szpunar et al., 2013). The results suggest that interspersing quiz questions throughout ›

learning can help with learning information presented later on in the class in comparison to not quizzing, because the quiz questions help relieve some of the interference that typically builds up during a longer learning session.

However, these studies did not test retrieval after a delay; they simply demonstrated that immediate recall on the information presented later during learning was better after previous information was quizzed than when previous information was not quizzed. Looking at long-term learning, in a set of three studies in the lab, online and in the classroom, we (Weinstein et al., 2016) did not find any differences between conditions when students were quizzed either throughout class or at the end of class. Importantly, students who were not quizzed at all did more poorly on the long-term learning tests. So, the take-home message is that it doesn't much matter where you put quiz questions, as long as you do give students retrieval practice opportunities in as many classes as possible.

So, how do we use retrieval practice in the classroom?

Research has demonstrated time and again that reconstructing knowledge by bringing information to mind improves meaningful learning – but how can teachers best leverage retrieval in the classroom? Some variables are important to consider, while others do not largely affect learning benefits from retrieval. Teachers need to ensure that students can be reasonably successful when practising retrieval, without making the task so easy that students no longer need to think back and bring the information to mind from memory. However, the format of retrieval and the timing of the questions within a lecture do not much matter. The important thing is to promote frequent retrieval practice in their classrooms.

REFERENCES

Butler AC (2010) Repeated testing produces superior transfer of learning relative to repeated studying. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 36: 1118–1133.

Carpenter SK (2012) Testing enhances the transfer of learning. *Current Directions in Psychological Science* 21: 279–83.

Hartwig MK and Dunlosky J (2012) Study strategies of college students: Are self-testing and scheduling related to achievement? *Psychonomic Bulletin & Review* 19: 126–134.

Jensen JL, McDaniel MA, Woodard SM et al. (2014) Teaching to the test... or testing to teach: Exams requiring higher order thinking skills encourage greater conceptual understanding. *Educational Psychology Review* 26: 307–329.

Kang SHK, McDermott KB and Roediger HL (2007) Test format and corrective feedback modulate the effect of testing on memory retention. *The European Journal of Cognitive Psychology* 19: 528–558.

Kapler IV, Weston T and Wiseheart M (2015) Spacing in a simulated undergraduate classroom: Long-term benefits for factual and higher-level learning. *Learning and Instruction* 36: 38–45.

Karpicke JD, Blunt JR, Smith MA et al. (2014) Retrieval-based learning: The need for guided retrieval in elementary school children. *Journal of Applied Research in Memory and Cognition* 3: 198–206.

Karpicke JD and Blunt JR (2011) Retrieval practice produces more learning than elaborative studying with concept mapping. *Science* 331: 772–775.

Karpicke JD, Lehman M and Aue WR (2014) Retrieval-based learning: An episodic context account. In: Ross BH (ed) *Psychology of Learning and Motivation, Vol 61*. San Diego, CA: Elsevier Academic Press, pp. 237–284.

Kornell N, Hays J and Bjork RA (2009) Unsuccessful retrieval attempts enhance subsequent learning. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 35: 989–998.

Little JL, Bjork EL, Bjork RA et al. (2012) Multiple-choice tests exonerated, at least of some charges: Fostering test-induced learning and avoiding test-induced forgetting. *Psychological Science* 23: 1337–1344.

Lyle KB and Crawford NA (2011) Retrieving essential material at the end of lectures improves performance on statistics exams. *Teaching of Psychology* 38(2): 94–97.

Mayer RE, Stull A, DeLeeuw K et al. (2009) Clickers in college classrooms: Fostering learning with questioning methods in large lecture classes. *Contemporary Educational Psychology* 34: 51–57.

McDermott KB, Agarwal PK, D'Antonio L et al. (2014) Both multiple-choice and short-answer quizzes enhance later exam performance in middle and high school classes. *Journal of Experimental Psychology: Applied* 20: 3–21.

Roediger HL and Karpicke JD (2006) Test-enhanced learning: Taking memory tests improves long-term retention. *Psychological Science* 17: 249–255.

Roediger HL, Putnam AL and Smith MA (2011) Ten benefits of testing and their applications to educational practice. In: Mestre J and Ross B (eds) *Psychology of Learning and Motivation: Cognition in Education*. Oxford: Elsevier, pp. 1–36.

Smith MA, Blunt JR, Whiffen JW et al. (2016) Does providing prompts during retrieval practice improve learning? *Applied Cognitive Psychology* 30: 544–553.

Smith MA and Karpicke JD (2014) Retrieval practice with short-answer, multiple-choice, and hybrid formats. *Memory* 22: 784–802.

Szpunar KK, Khan NY and Schacter DL (2013) Interpolated memory tests reduce mind wandering and improve learning of online lectures. *Proceedings of the National Academy of Sciences* 110: 6313–6317.

Szpunar KK, McDermott KB and Roediger III HL (2008) Testing during study insulates against the buildup of proactive interference. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 34: 1392–1399.

Weinstein Y, Gilmore AW, Szpunar KK et al. (2014) The role of test expectancy in the build-up of proactive interference in long-term memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 40: 1039–1048.

Weinstein Y, McDermott KB and Szpunar KK (2011) Testing protects against proactive interference in face–name learning. *Psychonomic Bulletin & Review* 18: 518–523.

Weinstein Y, Nunes LD and Karpicke JD (2016) On the placement of practice questions during study. *Journal of Experimental Psychology: Applied* 22: 72–84.

Six ways visuals help learning

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This article is based on articles originally published on https://teachinghow2s.com/

Whenever I talk about the power of visuals, I am very keen for the audience to understand I am not referring to particular people, or to the myth of 'visual learners'. However, we now know from research more about how learning occurs, so we can identify specific ways in which visuals support psychological processes. In this article, I reflect on six ideas, many of which are drawn from a 500-page tome on cognitive psychology research called *Graphics for Learning*, by Ruth Colvin Clark and Chopeta Lyons. Clark has worked with John Sweller and Richard Mayer.

1: Visuals support attention

When visuals are not merely decorative or entertaining, they can be used to bring essential information to the fore, for example through visuals such as numbering and arrows, and to draw attention to important elements. This can help avoid the burden of 'split' or 'divided attention'; when text is far away from the visual, or vice versa, the viewer has to expend considerable mental energy in keeping one in mind while attending to the other, increasing cognitive load.

2: Visuals help activate or build prior knowledge

By providing a visual overview of the process, visuals help trigger recognition and anticipate future content. This merging of past and future imagery helps connect to prior learning and assimilate future information.

3: Visuals help minimise cognitive load

Cognitive load is when working memory is overloaded and cannot process any more incoming information (Sweller, 1988). For this reason, photographs and videos can often be counter-productive, and simple line drawings are superior in conveying precise information. Background, or irrelevant detail, can distract, confuse or overwhelm the viewer.

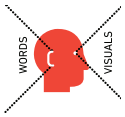
Additionally, some people are tempted to use what are termed decorative visuals, such as clip art, in an attempt to seduce students into taking an interest in the topic at hand. This, too, is counter-productive. It diverts attention away from the lesson's aims and, as a consequence, confuses and overloads.

4: Visuals help build mental models

Well-designed visuals help the viewer construct new memories in their long-term storage, supporting a deeper understanding of the concepts and procedures involved. By locating all the elements on one page — viewed in one go — visuals present a coherent image that is more easily assimilated and stored away for future reference.

5: Visuals help support transfer of learning

The simpler the visual model, the easier it is to retain it in memory for transfer into practice. By focusing solely on those aspects that are directly relevant, the visual model helps the viewer identify key components necessary for deeper understanding.



6: Visuals make use of dual coding

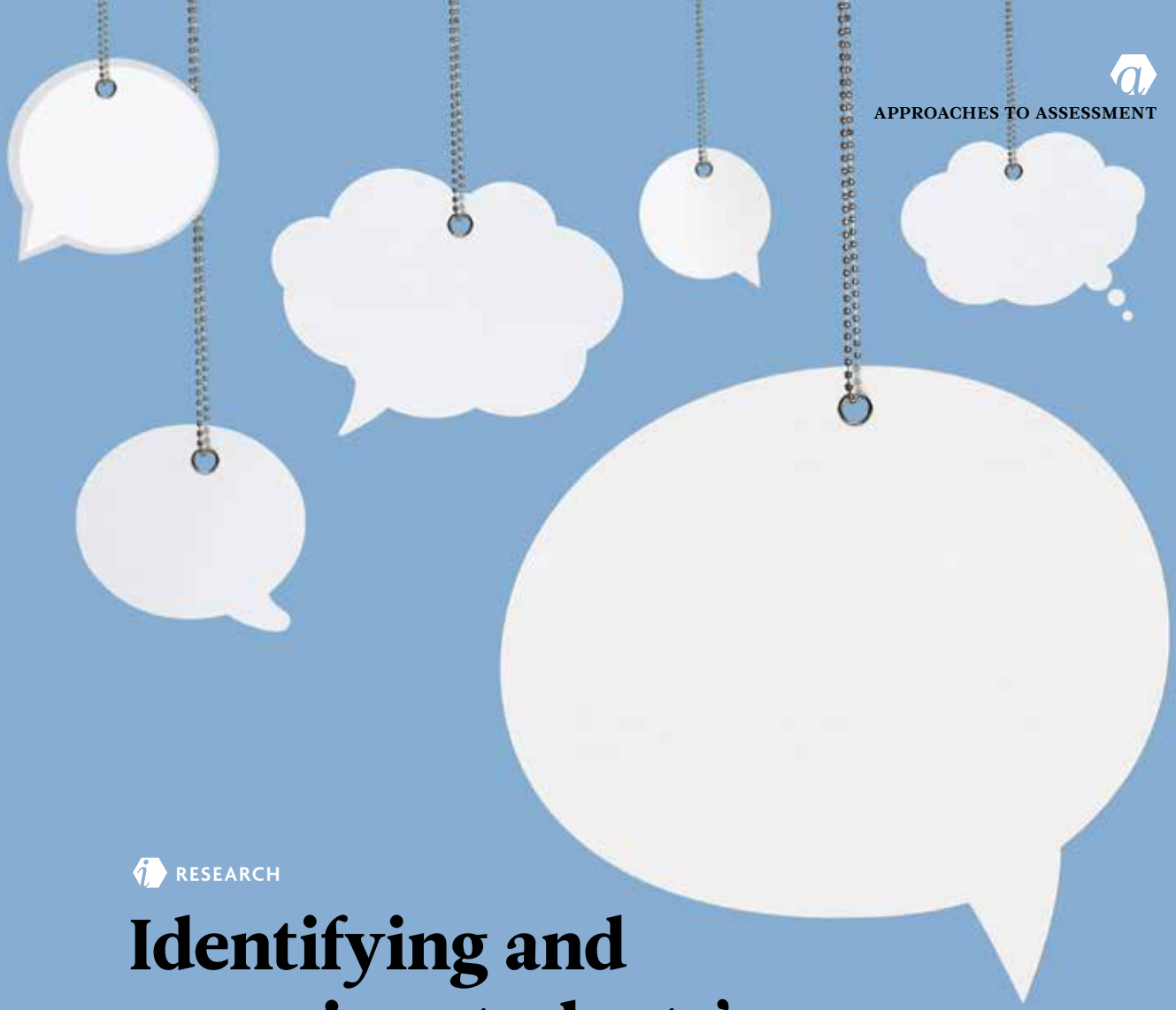
The idea of 'dual coding' theory (Paivio, 1986) is that we can use our visual and auditory channels simultaneously and, significantly, separately. This means that we can absorb more information than is normally considered possible – we avoid the dreaded cognitive load.

REFERENCES

Clark RC and Lyons C (2010) *Graphics for Learning: Proven Guidelines for Planning, Designing, and Evaluating Visuals in Training Materials.* Hoboken, NJ: John Wiley & Sons.

Paivio A (1986) *Mental representations: A Dual Coding Approach.* Oxford, England: Oxford University Press.

Sweller J (1988) Cognitive load during problem solving: Effects on learning. *Cognitive Science* 12: 257–285.



RESEARCH

Identifying and assessing students' spoken language skills

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In recent years, there has been a growing recognition of the need to help young people develop their abilities to use spoken language effectively. Employers commonly say that members of their workforce, especially those engaged in creative activities and customer-related roles, need well-developed skills in communication and collaborative problem solving. They want people who can make clear presentations, work well in teams, listen properly to people and solve problems collaboratively. Moreover, these are skills that equip young people for full participation in active learning in school, in democratic processes and life in general. If it is accepted that schools should be helping children to develop such skills, then teachers need ways of monitoring and assessing the talk skills of their students in a classroom setting so that they can aid their development.

It is for these reasons that, with funding from the Education Endowment Foundation and working with the London-based free school School 21, we created an oracy assessment toolkit for assessing how well children of 11-12 years old can use spoken English for different purposes and in different contexts. This age group corresponds with the first year of secondary school in most schools in the UK (and in many ›

other countries) and, by focusing on this age group in particular, teachers could make an initial assessment of their new intake as they arrived in school. The toolkit is designed for assessing all students as speakers of English, and not just those for whom English is a second language.

When developing the toolkit we examined the kinds of assessment tools that others had already developed and used. These included the schemes devised by the Assessment of Performance Unit (APU) in the UK back in the 1980s, The Scottish National monitoring survey, the assessments of public speaking made by the English-Speaking Union, the GCSE English speaking and listening assessments used by the various examination boards, SATS Key Stage 2 speaking and listening tests; and several from outside the UK, including the schemes created by Oracy Australia. Although we are not concerned with assessing the developing use of English as a second language, we also looked at methods that have been used to assess the progress of second language learners. The survey of these diverse assessment tools proved very valuable, not least in helping us avoid reinventing wheels.

During the development of the Skills Framework we also consulted members of an expert group, including people with expertise in drama, English teaching, modern language teaching, linguistics, speech therapy and educational assessment. We were pleased with the quality of the constructive criticism they provided and with their enthusiastic support for the development of the toolkit. However, their comments did cause us some serious reflection about, and revision of, both the framework and our assessment tasks. The same is true for the secondary teachers (mainly of English, though also some modern foreign language teachers) we consulted and involved in testing out the assessment instruments. They were based in schools serving different kinds of catchments: inner London and Coventry, and rural Cumbria, Hertfordshire and Cambridgeshire. From them we gained much useful feedback on both the framework and the tasks; and the teachers provided valuable insights that helped us to avoid unnecessarily technical or complex ways of describing the language features with which we were concerned.

The components of the toolkit

The toolkit consists of a set of initial tasks, a set of curriculum-embedded, assessment for learning (AfL) tasks for use throughout the year and a set of end of year tasks, together with a system for assessing performance on these tasks and giving feedback to the children. We aimed to make the use of the toolkit as flexible as possible, so that teachers can use any or all of the AfL tasks at any points in the school year, with any number of children, depending on the circumstances within a school. The materials also include video examples of Year 7 students carrying out the tasks, and explanations of how these have been rated using the assessment scheme.

The Oracy Skills Framework (as shown in **Figure 1**) provides an important foundation for the toolkit. We felt the need to develop it as there did not seem to be an available comprehensive model of the various skills that are needed to use spoken language effectively across a range of situations. Moreover, most previous approaches to assessing oracy seemed to rely on performance criteria related to specific situations, rather than being underpinned by a more general framework. It seemed to us that, while some communicative tasks or situations differ regarding which skills or performance features are most important for effective communication, some – and perhaps even most – skills will have general relevance. So, for example, although the ability to project one's voice will be more important when making a public speech than when involved in group work, and building upon what others say will conversely be more important in group work, in both types of tasks the ability to present one's ideas clearly to a specific audience would be a crucial issue. By offering teachers this kind of framework, we considered that they could construct an 'oracy profile' for any student, which would not just be situation-specific. Thus a student might be given the feedback that they are excellent at making a clear formal presentation to an audience, but need to develop their ability to listen to what others say in group discussions. However, we are aware of the limitations of profile scoring when there are high intercorrelations between profile components (Feinberg and Jurich, 2017).

Our skills framework for oracy was developed in several ways. Initially, we had some extended and productive discussions with our partners in School 21 about what constituted the effective use of spoken language, and what might realistically be expected of 11-year-olds in that respect. This made us all more aware of the diverse nature of the skills involved,

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FIGURE 1:
ORACY SKILLS FRAMEWORK

PHYSICAL
1. VOICE
2. BODY LANGUAGE

1. a) fluency and pace of speech; b) tonal variation; c) clarity of pronunciation; d) voice projection
2. a) gesture and posture; b) facial expression and eye contact

LINGUISTIC
3. VOCABULARY
4. LANGUAGE VARIETY
5. STRUCTURE
6. RHETORICAL TECHNIQUES

3. appropriate vocabulary choice
4. a) register; b) grammar
5. structure and organisation of talk
6. rhetorical techniques, such as metaphor, humour, irony and mimicry

COGNITIVE
7. CONTENT
8. CLARIFYING AND SUMMARISING
9. SELF-REGULATION
10. REASONING
11. AUDIENCE AWARENESS

7. a) choice of content to convey meaning and intention; b) building on the views of others
8. a) seeking information and clarification through questions; b) summarising
9. a) maintaining focus on task; b) time management
10. a) giving reasons to support views; b) critically examining ideas and views expressed
11. taking account of level of understanding of the audience

SOCIAL & EMOTIONAL
12. WORKING WITH OTHERS
13. LISTENING AND RESPONDING
14. CONFIDENCE IN SPEAKING

12. a) guiding or managing the interactions; b) turn-taking
13. listening actively and responding appropriately
14. a) self-assurance; b) liveliness and flair

with some being essentially 'physical' (such as voice control), some 'linguistic' (such as choice of vocabulary), some 'cognitive' (such as organization of content) and some 'social and emotional' (such as the ability to manage a group discussion). Those different aspects became the key organising categories of the framework – see **Figure 1**.

The assessment tasks have been designed to generate examples of young people's use of talk in three rather different situations:

1. making a presentational speech on a specific topic
2. working collaboratively in a group to discuss an issue and reach an agreement
3. working in a pair, with one person helping the other to perform a particular task (in this case, construction of a Lego model) by only using spoken language.

As mentioned earlier, videos of Year 7 students carrying out these tasks are available on the toolkit website: www.educ.cam.ac.uk/oracytoolkit. All of the other toolkit material can be downloaded free from that site. A more detailed account of how the toolkit was developed and validated can be found in Mercer, Warwick and Ahmed (2017).

Since the completion of our project, another scheme for assessing spoken language skills (which draws upon our own work) has become available as part of the LAMDA Level 2 Award in Speaking and Listening Skills (www.lamda.org.uk/examinations/schools-award). Both it and our toolkit show that it is possible to provide teachers with a framework for understanding the spoken language skills that their students will need to use to talk effectively in the various social situations they find themselves in; a set of tasks for assessing their students' oracy skills across a sample of such situations; and a rating scheme that provides a valid and fairly reliable way of assessing individual students' levels of competence and the progress they make over time. It is our hope that these developments will help to improve the amount and quality of oracy teaching in British schools, so that young people are better prepared for life in the 21st century.

REFERENCES

Feinberg RA and Jurich DP (2017) Guidelines for interpreting and reporting subscores. *Educational Measurement: Issues and Practice*, 36: 5–13. DOI: 10.1111/emip.12142 (accessed 24 August 2017).

Mercer N, Warwick P and Ahmed A (2017) An oracy assessment toolkit: Linking research and development in the assessment of students' spoken language skills at age 11-12. *Learning and Instruction* 48: 51–60.

Deepening knowledge through vocabulary learning

Effective vocabulary instruction: The underlying reasoning and research

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With the publisher's permission, sections of this article have been taken from *Beck and McKeown* (2007).

Vocabulary, particularly vocabulary teaching and learning, has been a topic that we have studied for over 25 years. In this article, we provide some of the research and theory that eventually coalesced into our books, *Bringing Words to Life* (Beck et al., 2002, 2013).

In the early 1980s, our understanding of several aspects of word knowledge commingled to stimulate our academic interest in vocabulary, eventually becoming integral to our principles of vocabulary learning. One aspect emerged from Curtis's (1987) findings from investigations of college students' vocabulary knowledge. Her research indicated that high-vocabulary students not only knew more words than those with lower vocabularies, but they also knew more about the words. Lower-vocabulary students tended to define words in terms of a specific context. For example, in the case of *surveillance*, lower-vocabulary people said something along the lines of 'that's what the police do', whereas high-vocabulary individuals were more likely to talk about surveillance in terms of 'watching'. As such, high-vocabulary people seemed better able to define words in a generalised and decontextualised way.

Alongside this, we were reminded that, as long ago as 1942, Cronbach presented descriptions of the knowledge and abilities involved in knowing a word, with *generalisation* being the ability to define a word; *application* the ability to select or recognise situations appropriate to a word; *breadth* the knowledge of multiple meanings; *precision* the ability to apply a term correctly to all situations and to recognise inappropriate use; and *availability* the actual use of a word in thinking and discourse. Our understanding of the important role of decoding-automaticity (sometimes referred to as efficiency) in comprehension – the ability to decode and understand text at the same time – prompted us to reason that word–meaning efficiency was similarly important for comprehension.

The need for fast access to one's representation of words in memory arises because comprehension is a complex process, in which several components vie for attention (Beck and Carpenter, 1986; Perfetti, 1985). Reducing attention on some components – in the case at hand, lexical search (the definition of a word) – may free attention to deal with other components, in particular the meaning of the ideas represented by words. With lexical access in mind, we included in our instructional design frequent encounters and thoughtful activities with target words, so that students had opportunities to develop fast access to strong representations of word meanings.

High-vocabulary students not only knew more words than those with lower vocabularies, but they also knew more about the words

Our approach

The approach to vocabulary instruction we initially developed was designed for use in classroom research that we undertook. It was aimed at developing flexible and multi-faceted representations of target words. Initially, we called such vocabulary instruction 'rich', but along the way, we changed the label to 'robust' instruction, as it seemed that this label captured our intention better. Below, we present the full range of components of robust instruction.

Introduce words through explanations in everyday connected language, rather than dictionary definitions

As we developed the instruction for our first study, we were quite dissatisfied with dictionary definitions for introducing word meanings to intermediate-grade students. We began to develop our own informal ways to explain the meanings, which we thought would be clearer and more helpful. This was the seed of our notion of student-friendly explanations. We became familiar with research showing that definitions are not effective for students (Miller and ›

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Gildea, 1985; Scott and Nagy, 1989), and have carried out research developing our notions of explanatory definitions more systematically (McKeown, 1993).

Provide several contexts in which the word can be used

Several sources of evidence demonstrated to us the need to design into the instruction multiple and varied contexts for each word. One source was Curtis's (1987) finding described above. Another was Werner and Kaplan's classic study (1952), showing that learners often imported features of the context into their developing understanding of an unfamiliar word. We found that, as former teachers, these sets of findings struck a chord of memory about students tending to stick to the context in which a word had been initially introduced. Thus, in the instruction we developed, multiple contexts were an important keystone.

Get students to interact with word meanings right away

A good explanation of word meaning and several contexts can provide a strong idea of a word's meaning, but it is still static information. Towards developing deep understanding, a student needs to interact with word information in some way. This perspective connects with currents theories of learning, which stress the active nature of successful learning, as well as with conceptions about levels of word knowledge. We implemented the notion of interaction with word meaning by providing quick activities with the words as soon as their meanings were introduced. For example, after encountering an explanation for *commotion*, students might be asked, 'Would there more likely be a *commotion* on the playground or in the library?' and then asked to explain 'why'.

Develop activities that require students to process the meanings of words in deep and thoughtful ways

Here, we reasoned that engaging students in simple associative tasks, such as matching a word with a synonym or definition, required only surface-level mental activity and would bring about minimal learning results. Our thinking was related to the notion that lower levels of mental effort would produce lower levels of knowledge. Since our goal was that words be known deeply and flexibly enough to enhance higher-level verbal tasks, we needed to develop instruction that required deep processing. All this led us to arrange instruction that required students to *think* about words and their meanings, identify and explain appropriate uses, create appropriate contexts and engage in various other reflective and analytical activities.

Learners often imported features of the context into their developing understanding of an unfamiliar word

Provide examples, situations and questions that are interesting

In the course of looking at commercial vocabulary-instructional materials, we noted that most examples were obvious and ordinary. A prime example was the context sentence provided for quarrel: *The teacher told the boys to stop quarrelling.* Note that it was an obvious protagonist (the teacher) and obvious antagonists (boys). It is of some irony that, in trying to provide students with the building blocks of language, there wasn't much of an attempt to use engaging examples or present novel contexts. Consider an alternative such as: *Dale's sister got tired of quarrelling with him about not using her CDs, so she set up an alarm system around her CD collection.*

Provide many encounters with target words

The importance of repetition in learning has a long history of research, and we adhered to that literature by providing many encounters for target words. We included this feature in our instruction, beginning in 1980. Subsequently, reviews by Stahl and Fairbanks (1986) and Mezynski (1983) identified frequency of encounters as one component that differentiated successful vocabulary instruction.

Word Wizard gimmick

We considered that if students' learning of their new vocabulary was simply a classroom activity, their understanding and use of the words could be limited to a school context, and the words would be less likely to become a permanent part of their vocabulary repertoires. So, a goal of instruction was to move students' learning beyond the classroom to increase the encounters with words and to enhance the decontextualisation of the words. To encourage outside learning, we developed a gimmick called *Word Wizard*, in which students could earn points by reporting having seen, heard or used target words outside of class.

Research

The features described above were incorporated into three studies. Extensive research articles are available about the results. Here, we briefly note that in an initial study and a replication (Beck et al., 1982; McKeown et al., 1983), we focused on the assessment of three aspects of verbal skill: a) accurate knowledge of word meanings; b) accessibility of word meanings during semantic processing; and c) reading comprehension.

In the initial and replication studies, experimental children significantly outperformed control children on word knowledge, as measured on multiple-choice tests, and accessibility of word meanings. Accessibility of word meanings was measured by children's reaction time on a word-categorisation task; children were shown a word on a screen and asked to press a 'yes' or 'no' button to indicate whether the word was, for example, 'a person'. Experimental children's performance on the accessibility task was also faster for instructed words compared to uninstructed words. The results of the task suggest that the words were learned well enough to be readily available for complex processing. The results of comprehension in the replication study were that recall of a story containing taught words was superior to that of a story with uninstructed words and to that of children who had not received the instruction. From these two studies, we concluded that instruction that improved accurate word knowledge and speed of semantic access could also influence reading comprehension.

A third study was designed to investigate the role of features of the instruction used in the first two studies: frequency (whether children had four or 12 encounters with each target word); type of instruction ('robust' or traditional, with only definitions and synonyms provided); and whether the *Word Wizard* extension activity was included or not. The results of this study are covered in detail in the online version of this article, but we found that whilst even a few – in this case, four – encounters with a word within traditional instructional activities will produce some limited results, a greater number of encounters with words is generally more helpful towards a variety of vocabulary learning goals. Only robust instruction, meanwhile, and only in the high-encounter condition, was powerful enough to affect comprehension, and instructional conditions that encouraged extension beyond the classroom, by including use of the *Word Wizard* device, held advantage in making knowledge about the words more readily available for processing. To sum up succinctly, students need to wallow in words and their uses if they are to develop the kind of vocabulary repertoires that will serve them in school and, indeed, in life.

Making vocabulary stick

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Education depends upon reading, and all reading depends upon vocabulary. With the help of Shireland Research School, I have designed an intervention to improve secondary-school-age children's vocabulary knowledge. I have taken as a lodestone for this endeavour ED Hirsch's well-known comment: 'Broad, shallow knowledge is the route to independence...' (Hirsch, 1988). I have also been informed by the excellent Learning as a Generative Activity, which states that ›

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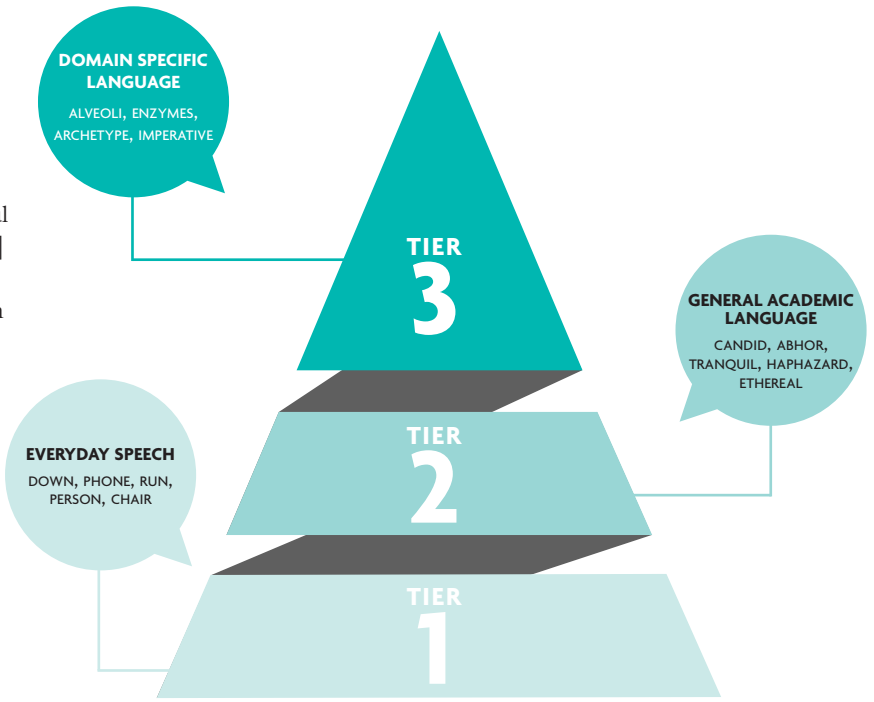
'more generative practice tests... may lead to the best long-term learning' (Fiorella and Mayer, 2015, p. 111). Robert Bjork (2012) further explains that self-testing has a more powerful effect without cues or being primed. The most influential text, however, is *Bringing Words to Life* (Beck et al., 2002). It provides robust and clear instructional methods for making vocabulary stick. One of the most powerful takeaways for me is: '[You need to acquire] 400 words a year to make a significant contribution to verbal functioning', which gives me a rough goal against which to measure. There are also references to the ineffectiveness of dictionary work, which spoke to me as, when I was first Head of English a long while ago, colleagues asked if we could 'finally' buy dictionary boxes. I agreed with pleasure. Years later, the dictionaries sit in boxes around the department, underused and of limited impact. *Bringing Words to Life* explains a better way to capture meaning for students than looking in a dictionary! However, what gets educators particularly interested is the famous reference to 'tier 2 language', illustrated in **Figure 1**.

FIGURE 1:
TIERS OF DOMAIN SPECIFIC LANGUAGE ILLUSTRATED



Tier 2 words are essentially 'more mature and precise' words for ideas that students already have. This is where Hirsch's 'shallow... to deep knowledge' idea is most helpful. The more tier 2 words a student has, the better equipped they are to read a range of texts.

Accordingly, I created a list of tier 2 words. I downloaded about 1,600 words from a US website named Flocabulary (www.flocabulary.com). I then simply chopped out words I thought were too simplistic, created a spreadsheet and enabled it to randomly present different words in a form of spaced retrieval. If you so wish, you can download the list from my blog (thespacebetweenclub.wordpress.com).

Through discussion and 'cold call', students will acquire working definitions of about 10 words each lesson. I will next use generative learning, which should take about 15 minutes of one lesson a week. Here are some examples: one activity is to challenge students to generate situations, contexts and examples, therefore integrating their new vocabulary. For example, *How might a (1) cook (2) musician (3) basketball player (4) teacher show they are (1) versatile (2) expert (3) industrious (4) innovative?* Or perhaps an even more demanding example of generative elaboration: *Do people with privilege prosper? What might a meticulous person be vulnerable to?*

The more tier 2 words a student has, the better equipped they are to read a range of texts

Bringing Words to Life has a panoply of activities to help secure students' understanding and, therefore, boost vocabulary in the long term, the goal being that young people become increasingly confident readers and successful learners across the curriculum. I am particularly curious as to whether the tasks that are more demanding generatively have greater impact or stickiness. Through the project, which will launch in September 2018, I hope to explore the best ways to ensure vocabulary sticks.

Building vocabulary across a 3D curriculum

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In building our curriculum, we sought to structure it so that key concepts and vocabulary were revisited and reinforced, making them unforgettable. As a result, we constructed a 3D curriculum where explicit links were made within subjects, across subjects and across years, with repetition of vocabulary at its heart.

Beck's work (2013) gave us strategies to reinforce vocabulary within a unit of work and, by dividing words into three tiers, helped us decide which words would have most impact. However, when thinking about teaching for long-term learning, we decided that the most important vocabulary sometimes straddled tiers 2 and 3. We've dubbed these '2.5' words. These are words that may begin as technical 'tier 3' words, but become appropriated and used in a looser way. For example, children may first encounter the word 'meander' as a tier 3 word in geography, when studying rivers, but then encounter it in English when it is used to describe someone's thoughts or journey. Reminding children of the 'tier 3' usage not only consolidates recollection of the technical use, but also aids comprehension of the looser tier 2 meaning.

We thought about where these opportunities may occur across the curriculum. There's no point in a teacher simply saying, 'remember when you studied rivers in geography?' and assuming that children will make the right links. Instead, they need to be explicit and go over the technical meaning, even if the original exposure to the word did not take place in their year group or subject. This has meant highlighting which vocabulary we want staff to reinforce. For example, consider the words 'tyrant', 'tyranny' and 'tyrannical'. Children first encounter 'tyrant' in the Early Years, learning about dinosaurs and Tyrannosaurus Rex. So when teaching about King John and the Magna Carta, teachers exploit this prior knowledge when describing an oppressive ruler as tyrannical. Later history lessons, studying Hitler, provide opportunities to revisit the idea of tyranny and remind ourselves of when we have encountered it previously. Each time we revisit a tier 3 word in a different setting, our understanding of it becomes denser – more solid and more nuanced.

It's not just about being clear about tier 3 vocabulary in other subjects, or tier 2 vocabulary in English, it's also about looking for ways in which we can take some of this vocabulary 'for a walk' across our 3D curriculum.

The online edition of this journal includes two further articles exploring approaches to vocabulary instruction: *Breathing life into vocabulary teaching in the primary classroom* by Sonia Thompson, and *Word power: Creating a language-rich environment* by Kelly Ashley. These can be accessed at: impact.chartered.college.

REFERENCES

Beck IL and Carpenter PA (1986) Cognitive approaches to understanding reading: Implications for instructional practice. *American Psychologist* 4(10): 1098–1105.

Beck IL and McKeown MG (2007) Different ways for different goals, but keep your eye on the higher verbal goals. In: Wagner RK, Muse AE and Tannenbaum KR (eds) *Vocabulary Acquisition: Implications for Reading Comprehension*. New York: Guilford Press, pp. 182–204.

Beck IL, McKeown MG and Kucan L (2002, 2013) *Bringing Words to Life: Robust Vocabulary Instruction* (2nd ed). New York: Guilford Press.

Beck IL, Perfetti CA and McKeown MG (1982) Effects of long-term vocabulary instruction on lexical access and reading comprehension. *Journal of Educational Psychology* 74(4): 506–521.

Bjork RG (2012) Input less, output more. *GoCognitive*. Available at: http://www.gocognitive.net/interviews/input-less-output-more (accessed 30 March 2018).

Cronbach LJ (1942) An analysis of techniques for diagnostic vocabulary testing. *Journal of Educational Research* 36(3): 206–217.

Curtis ME (1987) Vocabulary testing and instruction. In: McKeown MG and Curtis ME (eds) *The Nature of Vocabulary Acquisition*. Hillsdale, NJ: Erlbaum, pp. 37–51.

Fiorella L and Mayer RE (2015) *Learning as a Generative Activity: Eight Learning Strategies that Promote Understanding*. Cambridge: Cambridge University Press.

Hirsch ED (1988)

Cultural Literacy: What Every American Needs to Know. New York: Vintage Books.

McKeown MG (1993) Creating effective definitions for young word learners. *Reading Research Quarterly* 28(1): 16–31.

McKeown MG, Beck IL, Omanson RC et al. (1983) The effects of long-term vocabulary instruction on reading comprehension: A replication. *Journal of Reading Behavior* 15(1): 3–18.

McKeown MG, Beck IL, Omanson RC et al. (1985) Some effects of the nature and frequency of vocabulary instruction on the knowledge and use of words. *Reading Research Quarterly* 20(5): 522–535.

Mezynski K (1983) Issues concerning the acquisition of knowledge: Effects of vocabulary training on reading comprehension. *Review of Educational Research* 53(2): 253–279.

Miller GA and Gildea PM (1985). How to misread a dictionary. *AILA Bulletin*. Pisa: International Association for Applied Linguistics.

Perfetti CA (1985) *Reading Ability*. New York: Oxford University Press.

Scott J and Nagy WE (1989) Fourth graders' knowledge of definitions and how they work. In: *Annual Meeting of the National Reading Conference*, Austin, Texas, USA, December 1989.

Stahl SA and Fairbanks MM (1986) The effects of vocabulary instruction: A model-based meta-analysis. *Review of Educational Research* 56(1): 72–110.

Werner H and Kaplan E (1952) The acquisition of word meanings: A developmental study. *Monographs of the Society of Research in Child Development* 15(1): i–iii, v–vii, 1, 3–120.

Speaking up: The importance of oracy in teaching and learning

How can teachers support oracy in their classrooms?

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Speech and communication lies at the heart of classroom practice. It is the predominant way in which teachers provide instruction and support to their students and is central to how most students engage with the curriculum. This article examines how teachers can support oracy in the classroom, drawing on research commissioned by Voice 21, an organisation working with UK schools to support the teaching of spoken communication skills, and undertaken by LKMco, a think tank working across the education and policy sectors.

What is 'oracy'?

Oracy can be seen as an outcome, whereby students learn to talk confidently, appropriately and sensitively. This article focuses on oracy as a **process**, whereby students learn through talk, deepening their understanding through dialogue with their teachers and peers (Alexander, 2012). Oracy involves teachers and their students thinking carefully and deliberately about the sorts of spoken language they are using, and this will vary across subjects and with different age groups. Different types of talk will be appropriate

at different points in the learning cycle, and Robin Alexander outlines five key types of 'teaching talk' (2008):

1. **Rote:** imparting knowledge by getting students to repeat key pieces of information to convey facts, ideas and routines
2. **Recitation:** using questions to test students' knowledge and understanding, to check students' progress, and stimulate recall
3. **Instruction:** telling students what to do and explaining key facts, principles or processes in order to transmit information
4. **Discussion:** encouraging the exchange of ideas within a class, to share information
5. **Dialogue:** using structured questions and discussion, helping students deepen their understanding of key knowledge, principles and processes.

What are the benefits of developing teachers' and students' oracy?

Developing classroom talk has a wide range of benefits on students' outcomes during school, and beyond. In particular, structured dialogue during lessons, where students are encouraged to participate verbally and given space and time to reflect upon and discuss complex ideas, is linked with:

- **Cognitive gains**, including improved results in English, maths and science, the retention of subject-specific knowledge and 'transference' of reasoning skills across subject areas (Jay et al., 2017)
- **Personal and social gains**, including attitudes towards learning, enhanced self-esteem and self-confidence, and a reduction in anxiety (Hanley et al., 2015; Gorard et al., 2015)
- **Civic engagement and empowerment**, increasing children and young people's ability to debate issues, while also increasing understanding about social issues and ability to manage differences with others (Nagda and Gurin, 2007).

Recent Education Endowment Foundation-funded evaluations indicate raising the quality and rigour of classroom talk has a range of positive academic, personal and social outcomes, in particular for children eligible for free school meals (Gorard et al., 2015; Hanley et al., 2015) and in terms of teachers' confidence (Jay et al., 2017).

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How do teachers use oracy?

Teachers recognise the importance of developing oracy in their lessons. Drawing on the results of a poll of over 900 teachers, 11 interviews with oracy experts and 26 interviews and focus groups with teachers, school leaders and students in 13 schools, LKMco's research with Voice 21 highlights work taking place from the Early Years up to post-16 provision, in mainstream and special schools, and in the state and independent sectors (Millard and Menzies, 2016).

In the poll, over half of teachers said they model the sorts of spoken language they expect of their students, set expectations for their students' oracy, and initiate pair or group activities in most of their lessons. Early Years and primary teachers, and essay-based subject teachers, tend to initiate such activities with greater regularity than their colleagues.

Exploring the strategies used in classrooms to support students' language learning, Dockrell et al. (2012) find teachers use some strategies more regularly than others. Their analysis of language learning environments, opportunities and interactions in 101 Reception and Key Stage 1 classes using the Communication Supporting Classroom Observation Tool (CSCOT) found:

- Small group work was the most common language learning opportunity across the year groups studied
- The use of gesture and open questions were among those used regularly by teachers
- The encouragement of new words, turn-taking and listening skills were among the interactions observed less regularly.

One particular type of verbal interaction that features heavily in whole-class teaching is teacher-led recitation, in which the teacher asks a question, a student responds and the teacher evaluates their answer. Studies of classroom discourse suggest this form of interaction is highly prevalent throughout schooling, and that the questions themselves tend to seek predictable answers. While this has its uses, it is of limited use in prompting students to explore more elaborate ideas (Smith et al., 2004).

Raising the quality and rigour of classroom talk has a range of positive academic, personal and social outcomes ›

A quarter of respondents talked about avoiding oracy-based activities for fear of making shy or under-confident students uncomfortable

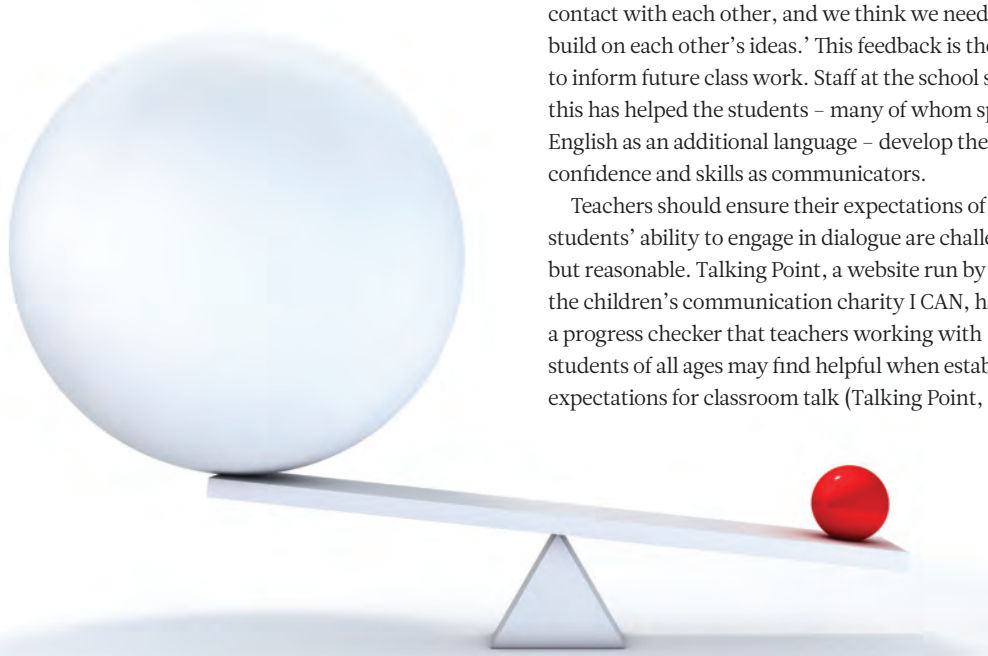
What are the barriers to better oracy?

Despite the importance teachers place on developing students' oracy, LKMco's research found there are barriers to them doing so (Millard and Menzies, 2016). A lack of time is the most common, cited by 31% of teachers. A quarter of respondents talked about avoiding oracy-based activities for fear of making shy or under-confident students uncomfortable. Consequently, the students who might potentially benefit most from such activities can miss out. Another common concern, cited by one in five respondents, is that discussion and dialogue will lead to disruption, prompting some to avoid such activities altogether.

An additional challenge faced by teachers and schools wanting to develop and extend oracy is that there is 'nothing to show for it'. Interviewees felt this was a response to 'high stakes' accountability, wherein teachers feel under pressure to ensure students produce lots of writing.

How can teachers and schools overcome these barriers?

Individual teachers, groups of teachers, and whole schools can work to support their students' oracy.



Teachers can:

- Set clear 'ground rules' for talk during lessons (for example, by clarifying how and when students can contribute to class discussions, and what 'active listening' involves). Whole schools can also set expectations in this regard, such as in terms of how students should speak to their peers, and to staff and visitors.
- Model the talk they expect from students (in terms of tone and etiquette, as well as vocabulary and content).
- Ask great questions, encouraging different sorts of thought processes at different stages in the learning process. For example, teachers might prompt students to recall information at first, before then encouraging a deeper exploration of ideas.
- Scaffold students' interactions and responses during lessons, for instance, by using sentence starters.
- Provide students with feedback on both what they say and how they say it.
- Seek and give colleagues feedback on their classroom talk during development lesson observations.

Teachers at Eastwood Primary School in Keighley, for example, make video recordings of students at work, and then help the children evaluate their interactions in lessons. Riz Saleem, a Year 6 teacher, said students reflect both on the content itself and on how they interact with one another. They might say, for example, 'Miss, we don't think we made eye contact with each other, and we think we need to... build on each other's ideas.' This feedback is then used to inform future class work. Staff at the school said this has helped the students – many of whom speak English as an additional language – develop their confidence and skills as communicators.

Teachers should ensure their expectations of students' ability to engage in dialogue are challenging but reasonable. Talking Point, a website run by the children's communication charity I CAN, has a progress checker that teachers working with students of all ages may find helpful when establishing expectations for classroom talk (Talking Point, 2018).

Promoting oracy in the classrooms has the potential to help diversify and strengthen pedagogy and deepen learning.

Learning through talk: Deepening subject knowledge through oracy

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What could an oracy-rich classroom look like and how could it support students to refine their subject knowledge and develop their understanding?

At School 21, in Stratford, East London, teachers provide students with opportunities to learn, both *to* and *through* talk. In practice, this means that students are encouraged to develop and revise their understanding through sustained and productive dialogue with their peers. When engaging in discussion, for example, students must have a system for turn-taking, and they must ensure that everyone has a chance to contribute and that when somebody speaks, their ideas are respected. Introducing 'ground rules for talk', as advocated by Dawes et al. (2000), has been particularly effective at teaching students the conventions of group talk and ensuring that everybody's voice is valued.

To ensure that the contributions students make to group discussions improve their reasoning and develop their understanding, students are also taught a number of 'talk moves' or 'roles'. These encourage students to develop and interact with their own and other's ideas by, for example, challenging, clarifying or probing a group member's idea. Students are also taught to build or elaborate on each other's ideas, rather than merely stating their own thoughts with no relation to what has been said previously. They are taught when to introduce a new line of enquiry or summarise a discussion and are encouraged to consider how these 'moves' can help further their thinking as a group.

The Oracy Framework, developed in conjunction with teachers at School 21 and Cambridge University, provides a lens through which to view the oracy skills required to engage in effective group talk, and can be an effective way of framing the teaching of these skills (Mercer, et al. 2017; see **impact.chartered.college/article/mercer-identifying-assessing-student-spoken-language-skills/**).

Teaching students the oracy skills they require to learn effectively *through* talk ensures that group talk develops both students' thinking and understanding. Anna Kyrk, Head of Curriculum at School 21, has developed a talk-rich approach to teaching Year 7 science, which provides students with plenty of opportunities to develop their scientific subject knowledge and understanding. She explains one strategy that has been particularly useful:

'Representing a scientific concept as a story, through pictures, has been a really effective way of immersing students in big scientific concepts. The students decode the stories through discussion in groups. I then layer in the key vocabulary needed to identify and describe the processes of complex ideas such as genetic mutation, variation and natural selection. By the end of a 40-minute session, students are able to explain these processes, using the story to support their explanations. My role is to listen in, to guide the discussion and move the students' understanding on through talk and effective questioning.

Becoming an oracy teacher has changed my practice significantly. In our classroom, I am not the holder of knowledge and my job is not to 'fill up' the students. We talk to discover, then we communicate what we have found out, backed up by the subject knowledge and key vocabulary that we have developed through talk. We are explorers together.'

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REFERENCES

Alexander R (2008) *Towards Dialogic Teaching: Rethinking Classroom Talk*. 4th Ed. York: Dialogos UK.

Alexander R (2012) *Improving Oracy and Classroom Talk in English Schools: Achievements and Challenges*. Extended and referenced version of a presentation given at a Department for Education seminar on Oracy, the National Curriculum and Educational Standards. London, 20 February 2012.

Dawes L, Mercer N and Wegerif R (2000) *Thinking Together: A Programme of Activities for Developing Speaking, Listening and Thinking Skills for Children Aged 8–11*. Birmingham: Imaginative Minds Ltd.

Dockrell JE, Bakopoulou I, Law J, Spencer S, and Lindsay G (2012) *Developing a Communication Supporting Classrooms Observation Tool: Research Report DFE – RR247-BCRP8*. London: Department for Education.

Gorard S, Siddiqui N and Huat See B (2015) *Philosophy for Children: Evaluation report and Executive Summary*. London: Education Endowment Foundation.

Hanley P, Slavin R and Elliott L (2015) *Thinking, Doing, Talking Science: Evaluation Report and Executive Summary*. London: Education Endowment Foundation.

Jay T, Willis B, Thomas P, Taylor R, Moore N, Burnett, C, Merchant G and Stevens A (2017) *Dialogic Teaching: Evaluation Report and Executive Summary*. London: Education Endowment Foundation.

Mercer N, Ahmed A and Warwick P (2017) Identifying and assessing students' spoken language skills. *Impact* 1: 15–17.

Millard W and Menzies L (2016) *The State of Speaking in Our Schools*. London: Voice 21/LKMco.

Nagda BA and Gurin P (2007) Intergroup dialogue: A critical-dialogic approach to learning about difference, inequality and social justice. *New Directions for Teaching and Learning* 111: 35–45.

Talking Point (2018) Progress checker. Available at: http://www.talkingpoint.org.uk/progress-checker (accessed 15 March 2018).

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Making sense of metacognition

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Amy's geography teacher has asked the class to prepare a short presentation about rainforest ecosystems. To plan this, Amy reflects on how she learned best on the last topic – using the school textbooks – and decides to read the relevant chapter before drafting her presentation points. However, when reading it, she decides that the chapter isn't explained clearly enough to improve her understanding. She starts to panic, as she was relying on this.

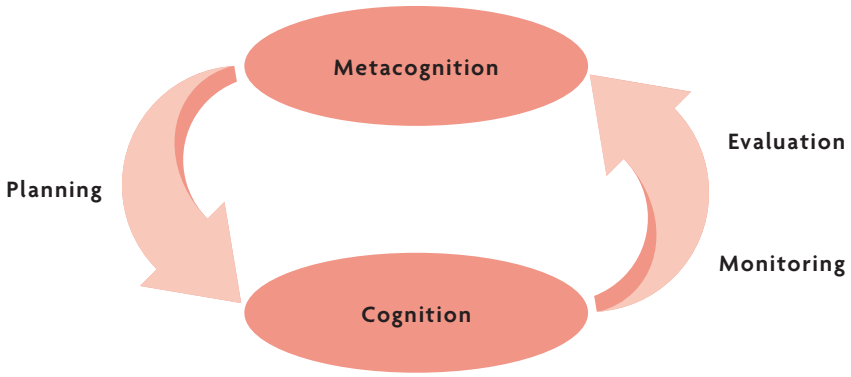
Then Amy remembers a geography website her teacher mentioned. She adapts her strategy and searches the website. This provides a more useful overview, and she uses the information to summarise some interesting facts. She reflects on the experience and decides that next time she will gather a range of resources before starting to research a topic, rather than relying on one source.

This short anecdote about Amy provides a familiar scene of schoolchildren grappling with their homework each evening in homes across England. When you dig beneath the surface of Amy's actions, you begin to consider how she thinks hard about her learning. Here, she is proving to be a successful learner, having internalised some effective strategies for *planning*, *monitoring* and *evaluating* her geography learning.

Most often, such learner behaviours are hidden in plain sight. Students like Amy go on to prove a success in geography and beyond, whereas some of Amy's peers simply flounder and fall away over time. Some teachers cultivate and nurture the metacognitive strategies used by Amy, explicitly naming them, guiding practice and promoting them daily, but many teachers do not do this so explicitly, so pupils may not develop the most effective strategies over time.

It becomes useful then to better define the key characteristics of effective learners, using well understood terms to underpin our practice in schools. The Amy example is a concrete example of **metacognition and self-regulation**. The Sutton Trust-Education Endowment Foundation's Teaching and Learning Toolkit (Education Endowment Foundation, 2018) suggests that it is one of the most effective approaches for improving pupils' attainment outcomes. So, how can teachers be helped to understand the terms? And how can the skills be developed and supported in the classroom?

FIGURE 1:
VISUAL MODEL OF COGNITIVE PROCESSES



Guiding teacher understanding of metacognition

Ask a staffroom full of teachers for a definition of metacognition and you will likely receive the familiar stock answer: 'thinking about thinking'. The problem here is that such a definition is vague and slippery. It certainly does not help a Year 5 teacher on a wet Wednesday afternoon, or a Year 11 maths teacher tackling trigonometry after break-time! Other definitions, such as 'learning to learn', are equally vague and can actually promote the misconception that metacognition is a generic skill that is not bound to subject knowledge – that we are not actually thinking about something.

There is a wealth of evidence to better understand metacognition so that teachers of every key phase, key stage and subject can support learners like Amy to thrive in and out of the classroom (e.g. Dignath and Büttner, 2008). If we can better define metacognition, we can go on to make it concrete for teachers and pupils, whilst dispelling some common misconceptions about what metacognition is, and what it isn't.

Metacognition is a part of self-regulation: those self-directive processes that direct our learning. As shown in the example of Amy, it requires:

- **Knowledge of yourself as a learner** (such as how Amy considers how she had performed successfully on her previous topic)
- **Knowledge of appropriate strategies** (such as how Amy drafts her presentation points and searches the internet)
- **Knowledge of the task** (such as how Amy knows that such a presentation requires the essential information offered by the textbook).

An effective learner will monitor their knowledge and cognitive processes, and use this understanding to make judgements about how to direct their efforts. Let's take the following example. Try this straightforward mathematics multiplication: 155 x 3. You may find it easy, but you will still draw upon some tried-and-tested strategies based on your maths knowledge, and you will have a good sense of whether your answer is correct. Now, how about 145,343,233 x 3? Here, you need to reflect a little bit more. You may know that you have too limited an array of mathematical strategies for this challenge. You may be rapidly searching for a calculator, at least to check your answer. It is in those moments when you are selecting the best strategy that you are behaving metacognitively.

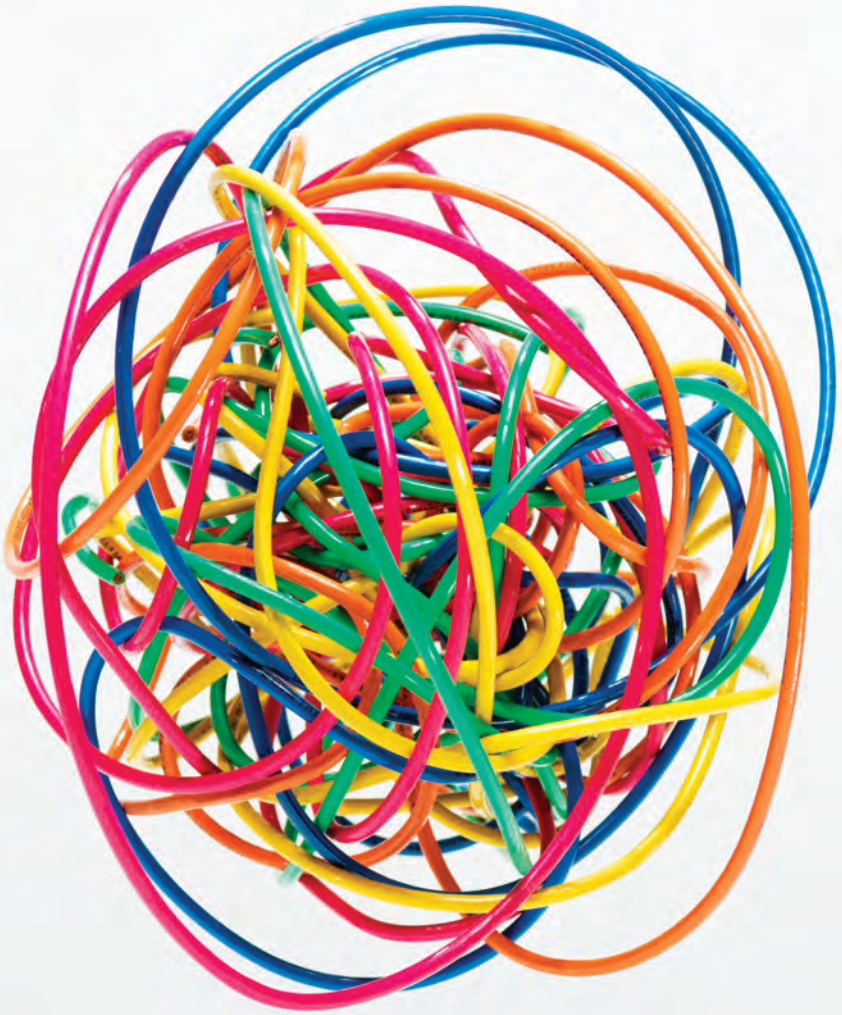
What we learn is that cognitive processes are controlled and adapted constantly. We are always making decisions about our learning in the moment. These decisions happen intuitively but, with explicit teaching and scaffolding, they can be better and more habitually enacted by pupils.

A visual model here is useful, as shown in **Figure 1** (adapted from Nelson and Narens, 1990).

This not a one-off process of discrete steps, but an ongoing cycle. As you progress through the task, you update your metacognitive knowledge (of yourself, your strategies and tasks), as well as updating your subject knowledge (in this example, Amy is learning about rainforest ecosystems, as well as learning about the best research strategies).

The cycle of '**plan**, **monitor**, **evaluate**' and the different aspects of metacognitive knowledge (**learner**, **strategies**, **task**) are recurrent triplicates that are helpful in making the understanding of metacognition concrete for teachers.

Teachers can then consider these when setting learning tasks and supporting pupils to complete them. In an expert learner (as most teachers are), these processes are unconscious and automatic. In novice learners, however, it can be valuable to make them explicit. For students like Amy, and for teachers, defining and better understanding metacognition can prove a crucial support factor for success in school.



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Dispelling metacognition misconceptions

One of the important ways for teachers to better understand metacognition and to teach pupils such strategies is to first dispel some common misconceptions about metacognition.

Misconception 1: Metacognition is a general skill that should be taught separately from subject knowledge

This is perhaps the most common misconception about metacognition. The clue is in the word: without cognition, there is no metacognition. Contrary to the misconception, metacognition is specific to the task and subject, and stronger where learners have a strong grounding in subject knowledge. It is, for example, very hard to have knowledge about how one can learn, such as through applying different strategies, in a subject without solid knowledge of subject-specific content and skills. For example, Amy must have a sound knowledge of the rainforest and its various levels, alongside the notion of an ecosystem, for her to decide the relevant evidence required from her textbook.

Therefore, teaching and practising metacognitive strategies must be done alongside subject content. Generic 'learning to learn' or 'thinking skills' lessons may be able to impart some useful overarching idea, but pupils can struggle to transfer generic approaches to specific subject domains. Self-regulated learning and metacognition have been found to be quite context-dependent, so how you best plan in Key Stage 2 art may have significant differences to planning strategies in Key Stage 4 maths. This does not, however, mean that metacognitive knowledge and skills will automatically develop through content knowledge teaching.

Misconception 2: Metacognition represents 'higher order' thinking and is therefore more important than mere cognition or subject knowledge

We know that metacognition is the knowledge of cognition and the strategies to regulate and control it. However, it would be a mistake to see metacognition as somehow 'higher order', hierarchically, and therefore more important than cognition (as Bloom's taxonomy is sometimes misinterpreted as being a hierarchy that privileges 'evaluation' over 'knowledge'). As has been pointed out, it is very hard to have knowledge about how competent you are in a given subject domain, or how best you can learn, without solid subject knowledge (Pressley and Harris, 2006).

For example, a student can use metacognitive planning strategies when

Teaching and practising metacognitive strategies must be done alongside subject content

drafting a GCSE essay about Shakespeare. But without knowledge of Shakespeare's plays, language and the relevant social context, the essay will not be successful.

Metacognition and cognition then display a complex interplay as our pupils learn. We should look to develop both concurrently and not create false hierarchies where they do not exist.

Misconception 3: Metacognition is only developed in older pupils

A common misconception with regard to metacognition knowledge and skills is that they are only developed effectively in mature young adults and not young children. We know from research, however, that children as young as three have been able to engage in a wide range of metcognitive and self-regulatory behaviours, such as setting themselves goals and checking their understanging (Whitebread and Coltman, 2010). They also show greater accuracy on tasks that they accept to do than on tasks they don't (Bernard et al., 2015).

There is clear evidence that the level of security and self-knowledge remains rather inaccurate until about eight years of age, with children being overoptimistic about their levels of knowledge (Clark and Dumas, 2016), but the overall trend suggests that forms of metacognition emerge early on in the lifespan. Ultimately, although older children do typically exhibit a broader repertoire of metacognitive strategies, younger children do generally demonstrate metacognitive knowledge, even at a very early age.

Metacognition in the classroom

All pupils develop metacognitive knowledge and skills in their time at school. And yet, some are more adept at doing this than others. They go on to make countless actions and decisions about their learning – many of which the teacher has little control over.

By improving their own understanding, teachers will be better able to support pupils to develop their metacognitive skills and knowledge

Recommendations from the evidence would suggest that teachers can be much more deliberate about teaching metacognitive awareness in the crucible of the classroom. A familiar example is 'shared writing', where the expert teacher (such as Amy's geography teacher) undertakes a written task. As she walks through an explanation of a jungle ecosystem, she verbalises the questions a geographer would ask of themselves, such as *'How many levels are there in the jungle ecosystem?'* and *'How could I organise that clearly in my writing?'*

As well as modelling and scaffolding explicit strategies, cultivating metacognitive talk between students can improve outcomes. For example, the 'dialogic teaching', as devised by Robin Alexander (2017), emphasises dialogue through which pupils learn to reason, discuss, argue and explain. A key element of the dialogic approach is to encourage greater quality of teacher talk, by going beyond the closed *teacher question – pupil response – teacher feedback* sequence. Importantly, in this and other successful interventions, dialogue needs to be purposeful and not just conversation, with teachers using questions to elicit further thought.

What an evidence-based understanding of metacognition offers us is a shared language with which to describe, define and teach effective learning. By improving their own understanding, teachers will be better able to support pupils to develop their metacognitive skills and knowledge. When we train our students to plan, monitor and evaluate, with conscious awareness within a given subject discipline, we offer them the knowledge and strategies to succeed, not only in the classroom but far beyond the school gates too.

This article is based on an EEF-commissioned evidence review examining these questions, drawing upon the expertise of Professor Daniel Muijs and Dr Christian Bokhove. A guidance report on metacognition and self-regulated learning for teachers and leaders was published by the EEF in April.

REFERENCES

Alexander RJ (2017) *Towards Dialogic Teaching: Rethinking Classroom Talk* (5th ed). York: Dialogos.

Bernard S, Proust J and Clement F (2015) Procedural metacognition and false belief understanding in 3- to 5-year-old children. *PLOS One* 10(10): e0141321.

Clark I and Dumas G (2016) The regulation of task performance: A trans-disciplinary review. *Frontiers in Psychology* 6: 1862.

Dignath C and Büttner G (2008) Components of fostering self-regulated learning among students: A meta-analysis on intervention studies at primary and secondary school level. *Metacognition and Learning* 3(3): 231–264.

Education Endowment Foundation (2018) *Sutton Trust-Education Endowment Foundation Teaching and Learning Toolkit*. London: Education Endowment Foundation. Available at: https://educationendowmentfoundation.org.uk/evidence-summaries/teaching-learning-toolkit/

Nelson TO and Narens L (1990) Metamemory: A theoretical framework and some new findings. In: Bower GH (ed) *The Psychology of Learning and Motivation* (vol 26). New York: Academic Press, pp. 125–173.

Pressley M and Harris KR (2006) Cognitive strategy instruction: From basic research to classroom instruction. In: Alexander PA and Winne P (eds) *Handbook of Educational Psychology* (2nd ed). Mahwah, NJ: Erlbaum, pp. 265–286.

Whitebread D, Coltman P, Pasternak DP et al. (2009) The development of two observational tools for assessing metacognition and self-regulated learning in young children. *Metacognition and Learning* 4(1): 63–85.

Developing metacognition in young children: The impact of talking about thinking using video reflection as a stimulus

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At the heart of effective classroom practice is the need to teach children to think well. This fascinates me, especially the mysteries of metacognition. I'm not alone. My recent online search revealed over four million entries for metacognition. However, there remains debate about this complex concept. I've been particularly interested in the question of whether or not young children can think metacognitively. This study explored the development of metacognition in young children (part of a larger study, which also considered teachers and their teaching of thinking).

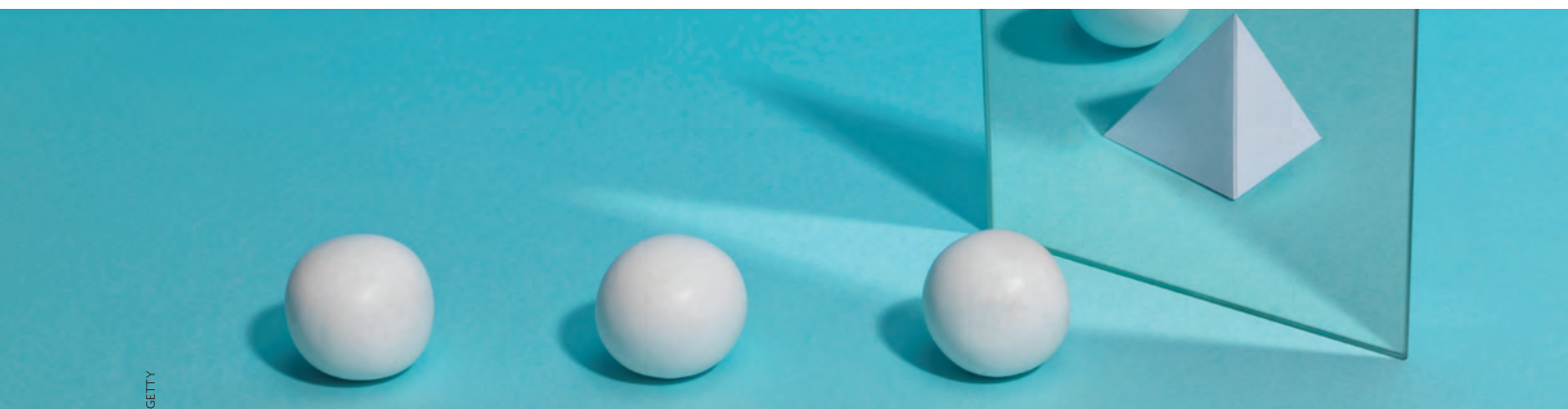
How did I define metacognition?

My definition of metacognition built on the original work of Flavell (1976, p. 232), who described the term as 'knowledge concerning one's own cognitive processes or anything related to them'. While acknowledging the existence of different models, for this study I defined metacognition as:

- The awareness individuals have of their own knowledge, their strengths and areas to develop, and their beliefs about themselves as learners
- Their ability to regulate their own action in the application of that knowledge.

Why should metacognition interest teachers?

Put simply, the purpose of teaching is to promote learning. While learning is shaped by many factors, meta-analysis indicates that helping children think more explicitly about their own learning can impact on their educational progress by as much as eight months (Hattie, 2012; Higgins et al., 2014). This makes ›



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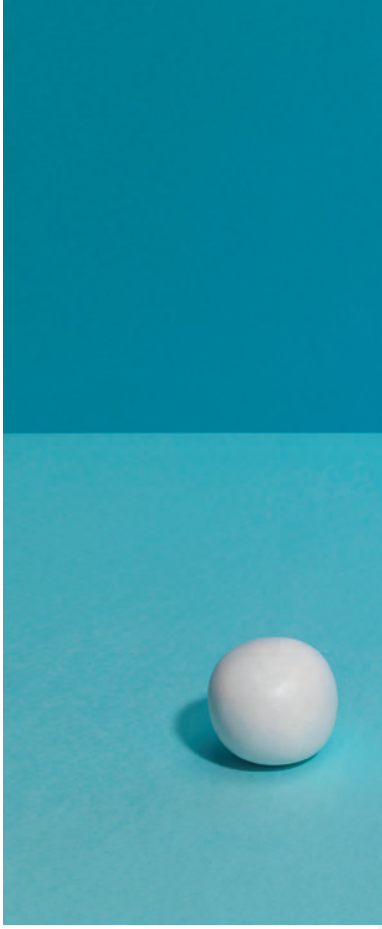

sense. Children who are aware of the processes that they are using to learn and how well these are working, and who can identify what they need to do to improve, are in a good position to learn.

What was the research question?

I became aware of a key debate around the age at which metacognitive awareness and behaviour are demonstrated (e.g. Larkin, 2015). In this paper, I focus on the question of whether or not four-to-six-year-olds can think metacognitively. Despite the apparent simplicity of this question, this is complex.

Shamir et al. (2009) suggest that it may be that the tools researchers use (such as interviews) are not appropriate for the youngest learners. It may not be that they cannot think metacognitively, but rather that research tools are not sensitive enough. Young children may lack the oracy skills to explain their thinking or to understand what the researcher is asking. Adult–child power dynamics may mean that some children are nervous or respond by telling adults what they think they want to hear. Teacher expectations may also affect how children respond; young children are less likely to be encouraged to reflect than older children (Waldron et al., 2014). I needed to use tools appropriate for young children and explore ways to develop their thinking.

What research approach did I use?

The study took a pragmatic, mixed-methods approach, using tools appropriate for young children and which did not rely solely on oracy. To find out what children thought about thinking, they were asked to draw pictures and they also looked at photographs taken from the internet, showing people doing activities like reading, playing or talking, with the children indicating whether or not they believed they showed people thinking.

I also used video-stimulated reflective dialogue (VSRD; Moyles et al., 2003). This involves using a video clip as a scaffold for dialogue. While this has been used with older children and with adults, it has been used less frequently with young children, and in those studies that have used it, the researcher has decided what was recorded and has taken responsibility for making the recording (e.g. Robson, 2016). In my study, the children had ownership. This was important in order to encourage participation and pupil voice (rather than relying on my interpretation of the children's actions).

The children decided who and what to film and which aspects we would discuss. They worked in pairs, quickly learning how to use the video camera (we used Flip cameras that could quickly upload clips onto a laptop to view). They took turns to make one short video of children in their class doing 'good thinking'. The pairs watched the clips together and decided which showed better thinking. They discussed this with me, talking about why they thought it was a good example. This promoted their own thinking – in the justification of decisions, for example, as well as insight into their awareness of thought processes. Discussion took place in a quiet learning space, with pairs of children and myself. The dialogue took place on the day that the video had been made, although not necessarily immediately after the session. The dialogue typically took 10 to 15 minutes.

I observed the children during normal classroom activities three times during the study. I analysed these observations to look for metacognitive behaviours using a coding framework based on Larkin's (2010) research.

The study followed BERA (2011) ethical guidelines, and appropriate, negotiated, ongoing verbal assent was gained from all children in each class.

Who participated?

Six schools, of varying size, location and demographics in Wales, were involved. The study ran for one academic year and took place in one class per school. In total, 36 children (aged 4.6–6.6 years) were involved. I visited each class on three occasions during the school year and worked with the same six children per class on each visit.

What were the findings?

During our discussions, the children were asked what they thought 'good thinking' looked like. Table 1 gives examples.

Children's understanding of thinking changed over time. Initially, they viewed good thinking as commensurate with good behaviour – for example,

Young children may lack the oracy skills to explain their thinking or to understand what the researcher is asking

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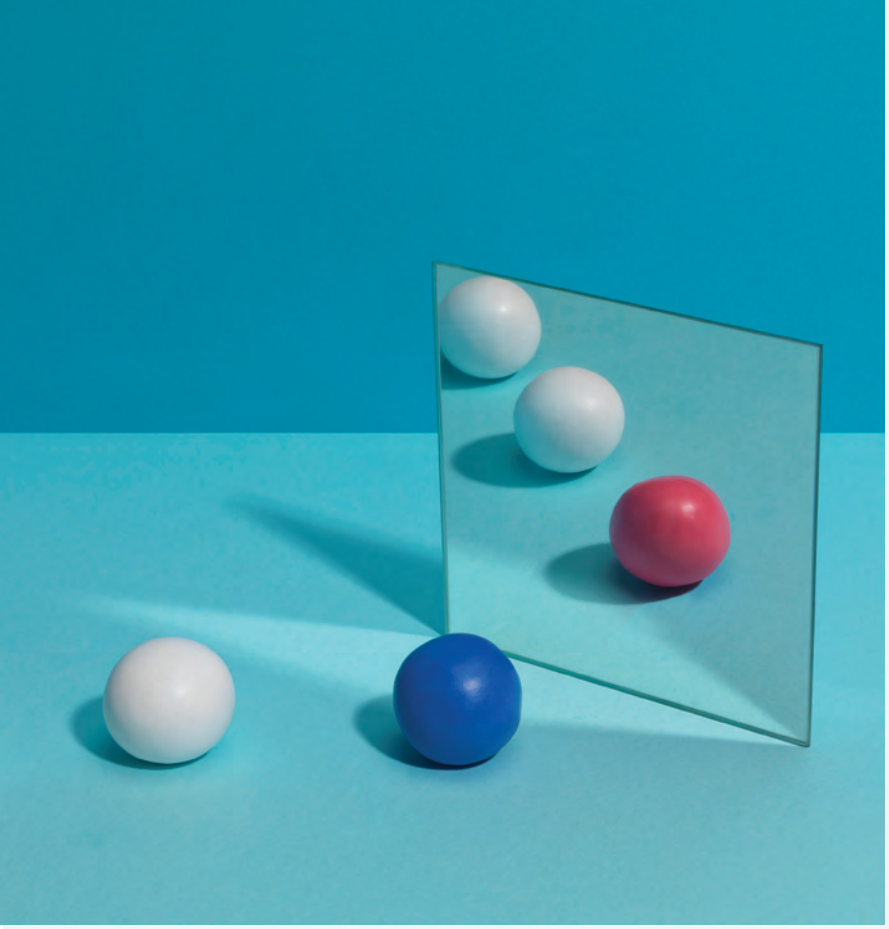

Sam suggests that it is to do with 'sitting quietly'. They expressed limited views about the nature of thinking, and drawings conformed to societal norms, such as 'bubbles' from the head. Some referred to their 'thinking caps', but none could explain what this meant or how it helped.

By the end of the study, children could expand on this. They were able to describe 'good thinkers' with more reference to strategy and understanding – for example, Chris refers to good thinkers as being able to 'make connections'. They could suggest strategies for when thinking was hard, such as visualising a number line in their head. They felt that their early drawings did not show the 'tricky' nature of thinking.

VSRD discussions also reflected a change in children's awareness of metacognitive behaviours. Initially, they chose to discuss clips that focused on children working quietly or being 'funny'. At the end of the study, their reasons and explanations were more detailed, and showed them being able to explain that their choices were related to thinking strategies. **Transcript 1** illustrates a dialogue.

The idea of having pictures and numbers in your head to help solve problems was commonly held at the end of the study. Peers perceived to be demonstrating such strategies were frequently filmed.

Lesson observations revealed metacognitive behaviours in all lessons throughout the study. At the start, the range of behaviours was narrow, and tended to happen after direct intervention from an adult. By the end of the study, the range of behaviours and the frequency with which they occurred increased. The behaviours happened increasingly independently. My findings support Robson's (2016, p. 192) suggestion that the type of talk that goes on in reflective dialogue may be 'particularly supportive of young children's self-regulation and metacognition'.

I cannot conclude that VSRD alone 'caused' the children to become more metacognitive. The study took place over a year, and maturational effects may account for some differences. The teachers in the study made thinking more visible in their classroom practices. The children saw me as someone who was interested in talking about thinking, and this may have encouraged them to discuss thinking more readily with me. Nonetheless, there are three key implications.

Implications

Firstly, VSRD allowed children the opportunity to engage in a dialogue in which they had ownership, and allowed them the opportunity to discuss their thinking deeply. The choice of ›

TABLE 1: **CHILDREN'S PERCEPTIONS OF THINKING AT START AND END OF STUDY**

CHILD (PSEUDONYM)	START OF STUDY	END OF STUDY
Chris	'They were sitting nicely'	'He's made a good connection'
Leuan	'They were looking at Miss'	'He's tapping his head, it helps with the pictures in his mind'
Sam	'She was sitting quietly'	'They are talking it through together to get ideas'
Sofie	'He's funny and my friend'	'She's looking really carefully at the work, she can start to work it out'
Grace	'He's listening'	'She's sounding it out so she can read the word'

TRANSCRIPT 1: **VSRD EPISODE**

Sofie: We filmed James, he looked at his work.

Me: Why was that important for good thinking?

Grace: He was looking, concentrating.

Me: What was he concentrating on?

Sofie: The number line.

Me: Oh, I can't see the number line.

Sofie: He didn't have one, only in his brain, so he was thinking hard about how to do it with the numbers in his head. He uses these 'cos when the numbers are big it's good to use the number line in your head.

what to film became more closely aligned to behaviours associated with thinking, and the children were better able to demonstrate and articulate their reasoning.

Secondly, VSRD provided a way to motivate and engage young children in the research process. Valkanova (2004, p. 44) suggests that although reflection is a 'crucial issue in learning', motivating children to reflect is a challenge. VSRD supported participation, and all children were keen to make and talk about their videos.

The third implication relates to the role of the adult during the reflective dialogue. Transcripts illustrate how children articulated their thinking as a result of the questioning that took place, and they may not have done so without the process and dialogue. Robson (2016, p. 190) suggests that when adults and children share videos, it forms a 'site for joint meaning making', allowing children the chance to have their thinking made more consciously available to them. As teachers, we need to reflect on our role in supporting children to think about their own thinking processes. VSRD has the potential to act as a motivating stimulus for this.

Conclusions

VSRD was a useful tool, enabling young children to reveal and reflect on their thinking. Children moved from a view of thinking as behaving well towards a view of thinking as an active, varied, specific activity. They were better able to articulate their understanding of thinking and demonstrated metacognitive behaviours more frequently. Of course, VSRD requires the luxury of time and access to appropriate technology, so is not an approach that could be used on a weekly basis. In this study, VSRD took place three times during the year, and this was manageable. Thinking well is empowering, and we can support even our youngest children to think more effectively. As Winnie the Pooh reminds us, thinking is a very good habit to get into! VSRD might help that habit get started.

REFERENCES

British Educational Research Association (2011) *Ethical Guidelines for Educational Research*. London: BERA.

Flavell JH (1976) Metacognitive aspects of problem solving. In: Resnick LB (ed) *The Nature of Intelligence*. Hillsdale, NJ: Erlbaum, pp. 231–236.

Hattie J (2012) *Visible Learning for Teachers*. Abingdon: Routledge.

Higgins S, Katsipataki M, Kokotsaki D et al. (2014) *The Sutton Trust-Education Endowment Foundation Teaching and Learning Toolkit*. London: Education Endowment Foundation.

Larkin S (2010) *Metacognition in Young Children*. Abingdon: Routledge.

Larkin S (2015) Metacognitive experiences: Taking account of feelings in early years education. In: Robson S and Flannery Quinn S (eds) *The Routledge International Handbook of Young Children's Thinking and Understanding*. Oxon: Routledge, pp. 189–198.

Moyles J, Hargreaves L, Merry R et al. (2003) *Interactive Teaching in the Primary School: Digging Deeper into Meanings*. Maidenhead: Open University Press.

Robson S (2016) Are there differences between children's display of self-regulation and metacognition when engaged in an activity and when later reflecting on it? *Early Years: An International Research* 36(2): 179–194.

Shamir A, Mevarech Z and Gida C (2009) The assessment of meta-cognition in different contexts: Individualized vs. peer assisted learning. *Metacognition Learning* (4)1: 47–61.

Valkanova Y (2004) Enhancing self-reflection in children: The use of digital video in primary science classrooms. *Journal of e-Literacy* 1: 142–155.

Waldron S, Rhys M and Taylor C (2014). *Evaluating the Foundation Phase: Key Findings on Pedagogy and Understanding*. Social Research Summary 43/2014. Cardiff: Welsh Government.

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Empowering SEN children through engaging in the arts

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High-quality arts provision has the potential to build self-belief and confidence in young people (Royal Shakespeare Company, Tate and University of Nottingham, 2018). This article discusses findings from the 'Young Arts Advocates Special School (YAASS)' programme, which aimed to build experiences and self-confidence for students with special educational needs, through schools and artists engaging in a rich dialogue and practice around the arts. The programme aims were to:

- develop arts accessibility and opportunities for children within Kent Special Educational Needs Trust (KSENT), enabling them to consider questions around their identity, self-awareness and confidence through the arts
- develop the opportunity for each school to gain their Artsmark, the creative quality standard for schools, accredited by Arts Council England, thus analysing the role of arts within the school's wider curriculum
- develop students' opportunities to explore and access a range of arts experiences, leading to individual Arts Awards
- engage in professional development and research into arts education involving teachers and artists to ensure a continued legacy for the project.

The YAASS was led by the Faculty of Education at Canterbury Christ Church University over two years, and was funded in partnership with Artswork (Bridge), KSENT and CLASS (Collaborative Learning Alliance Special Schools) and supported by Turner Contemporary, Jasmin Vardimon Dance Company, Drake Music, Marlowe Theatre and Kent Music. The programme consisted of 13 special schools in the East Kent area. Each of the schools is slightly different in ›

designation but they mainly range in age from four to 18, so the programme considered all key stages.

The programme consisted of the following key elements: auditing of expertise within schools and teachers; initial CPD for all involved, including senior leaders and governors; Artsmark training and initial statement of commitment; Arts Award training; working with artists and developing Arts Awards; exhibition and sharing; and then finally schools submitted their Artsmark case studies. Throughout the journey, the steering group – consisting of all schools and partners – met termly to shape the programme, share knowledge and identify CPD opportunities. The university researched programme impact through semi-structured interviews using a sample of six teachers and five artists, whilst triangulating this data through an analysis of the Artsmark statement of commitments and case studies.

Artsmark journey

From the analysis of the programme, the teachers identified that the Artsmark process had a clear whole-school impact. Curriculum development was a key aspect within this area. The use of Artsmark as a self-evaluation tool to reflect on and evaluate the schools' current provision enables teachers and senior leaders to create clear development plans, focusing on all arts subjects and cultural engagement. These development plans ensured that the arts had a higher profile within school, leading to greater engagement within curriculum and community. Several of the schools identified within their Artsmark case studies that this process had led to whole-school curriculum development using arts as a central theme. The Artsmark process became an essential tool for teachers and senior leaders to continue to engage with a professional dialogue around current arts provision and aspirational curriculum offer, with several schools considering next steps after their case study submission. Teachers also believed strongly that due to the students' complex needs, a conventional curriculum, as they perceived it, was not necessarily accessible or inclusive. However, an arts-rich curriculum enabled students to develop confidence in their skills, emotional understanding and regulation, knowledge and talents.

Working with artists

Throughout the journey, schools, teachers and students worked with a range of artists within the programme, including visual artists, ceramists, musicians, theatre practitioners and dancers. For example, the Wyvern Special School worked with international dance company Jasmin Vardimon Company. Considering the barriers to learning for students with complex needs, The Jasmin Vardimon Company developed a bespoke performance for the Wyvern School in their informal rehearsal space. Students engaged in excerpts of the live performance, so they could comfortably move, verbalise and interact throughout, without concerns for other audience members. For many of these students, it was the first opportunity to engage in a contemporary dance performance. This led into a rich opportunity for teachers and dancers to work collaboratively on workshops with students in school. Teachers and artists observed students develop their ability to express individual ideas through movement, working collaboratively with peers and developing confidence and enjoyment in their dance ability. One young man with complex needs, including communication, had been totally captured and inspired by the rehearsal space performance of Pinocchio, and subsequently totally absorbed and engaged with the work led by the dancers. This opportunity to explore and express movement through story enabled this young man to create and compose a dance piece independently, in which he played the part of the puppet, turning into a real boy. The impact for this student was clear progress in physical development, whilst there was also progress in his emotional understanding and empathy, as he started to understand the relationship between Pinocchio and his creator. This empowering experience of dance, and thus communication, enabled the student to reflect on and explore the personally distressing situation of the recent death of his grandfather. Thus, teachers and dancers observed the student's development of emotional resilience, with increased ability to communicate his feelings in different outlets, alongside a love for the skills of dance. These transferable skills will impact on and shape this student's and others' future opportunities. As Eisner (2002, p. 35) identifies, the arts can support 'complex forms of thought' for this student and others, and

Teachers and artists constructed innovative arts processes, and students were able to make significant progress across a range of skills linked to personal expression, communication, physical development and emotional wellbeing

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the dance supported this enabling, meaningful interpretation of the feelings portrayed, with students also understanding that dance can be a valued mode of communication and expression for them.

Artists developing inclusive practice

Artist practitioners working within the programme were also positioned as learners. Artists identified that if the artistic processes were to be successful, the development of bespoke inclusive practice was essential, which could only truly occur where a rich dialogue with school and teachers was enabled. This constructive dialogue enabled the artists to adapt processes, resources, equipment and teaching methods. Teachers brought a bespoke understanding of their individual students, whilst the artists understood, changed and manipulated the arts process to ensure that an inclusive approach for all students was achieved. All artists also identified that the opportunity they received to observe school settings and spend time with students prior to the co-construction of arts practice was fundamental to success. Although this may seem an expensive luxury, it became apparent that, when working with students with complex needs, understanding students' strengths, interests and engagement levels alongside the teacher impacted on the artists' ability to shape and develop inclusive arts practice, ensuring rich, high-quality learning outcomes.

The importance of steering groups

Throughout the project, the steering group led by CCCU met termly; this became a central point to introduce the schools to other partnerships such as Kent Music and Turner Contemporary, adding value to the programme throughout. The Turner Contemporary embraced this opportunity, working with the steering group to support accessibility to the gallery for their students, and offering the generous opportunity for the schools to curate, with artists' engagement, an exhibition of the students' works. The exhibition – 'YAASS: Empowered' – was shown to the public in the Turner Contemporary from 13 November 2018 until 6 January 2019. For most students, they had not previously had the confidence or opportunity to visit the gallery space, but the exhibition developed a sense of belonging and confidence in the young people to visit the gallery and share their art within their community. Teachers also felt that the exhibition empowered an acceptance of the students' identity, which in turn ensured that they felt valued as artists, which has a long-term impact on their self-belief and the way in which they perceive the arts. The steering group also became a key network for sharing opportunities, knowledge and peer-to-peer support, allowing teachers to share experiences, processes and knowledge, which all teachers stated that they valued.

In conclusion, where the programme was most successful, the following key elements were identified: firstly, where a successful arts-rich curriculum was developed or enhanced, it had clear support from senior leadership, including the governing body. Teachers articulated that the Artsmark process formulated a framework to initially evaluate the curriculum and then promoted ongoing conversation with teachers and teaching assistants but, most importantly, also senior leaders and governors.

Secondly, teachers and artists felt that students were most empowered within the arts when both teacher and artist were positioned as experts within the programme, with time to invest in collaboration to develop an inclusive process, such as developing and exploring new mediums. Artists strongly advocated that time to observe and understand the different student cohorts was essential for quality provision. Therefore, teachers and artists truly constructed innovative arts processes, and students were able to make significant progress across a range of skills linked to personal expression, communication, physical development and emotional wellbeing. This also enabled the richest continued professional development and the greatest legacy for teacher, artist and school, changing and developing future practice.

Finally, schools that embraced all aspects of the programme have developed lasting relationships with arts organisations such as the Marlowe Theatre, Turner Contemporary and Kent Music, whilst also building the network of knowledge and arts experts within KSENT. These schools have also embraced the opportunity to offer Arts Awards at a range of different levels, ensuring that all their students can obtain an arts accreditation.

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REFERENCES

Eisner E (2002) *The Arts and the Creation of The Mind*. London: Yale University Press.

Royal Shakespeare Company, Tate and University of Nottingham (2018) Time to listen. Available at: https://researchtale.files.wordpress.com/2018/10/time-to-listen-report2.pdf (accessed 29 July 2019).

Knowing your subject: The role of disciplinary knowledge in effective teaching

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Changing perspectives

When I began teaching, back in 2003, I was frequently told that I was a teacher first and subject specialist second. There was a prevalent idea that we should be teaching generic transferable skills, such as evaluation or interpretation, and that our subjects were just a vehicle through which this was delivered. This was reflected in a national curriculum that was light on specific content and remote from developments at the 'frontiers of the subject' (Marsden, 1997, p. 241). (For more on the place of facts, knowledge and skills within the curriculum, see Christodoulou (2014)).

More recently, however, there has been a growing recognition that a teacher's subject knowledge is vitally important. In a review of research behind effective teaching, Coe et al. (2014, p. 2) found that a teacher's subject knowledge, and their understanding of how pupils handle this subject, has strong evidence of impact on student outcomes.

We can see this need for excellent subject knowledge in Rosenshine's Principles of Instruction (2012). Like Coe's work, this looked at the defining characteristics of effective teaching and found, among other things, that effective teachers were able to provide detailed explanations of the material they were teaching. He writes that:

'In a study of mathematics instruction, for instance, the most effective mathematics teachers spent about 23 minutes of a 40-minute period in lecture, demonstration, questioning and working examples. In contrast the least effective teachers spent only 11 minutes presenting new material.' (p. 14)

Rather than overwhelming students by presenting too much new information at once, effective teachers checked students' understanding along the way. Some taught by giving a series of short presentations using many examples, providing elaboration that proved useful for processing new material. We can't lecture, demonstrate, question and provide worked examples unless our knowledge is sufficient for us to do so.

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How can we maintain and improve our subject knowledge?

In many subjects, we need to ensure that our knowledge is broad as well as deep. Pupils learn best when they are provided with a wide variety of examples to illustrate an abstract concept

(Willingham, 2009). In geography, I might want pupils to understand the idea of appropriate technology. To achieve this, I need to draw on a wealth of examples from my own subject knowledge: tractors in North Africa, the Play Pump scheme in South Africa or sanitation projects in rural India.

If we accept that subject knowledge is important to successful teaching, what can we do to improve the knowledge we have?

One strategy is just to prepare very well for each lesson. In his recollections of the effective teachers he encountered, both in his own school days and, later, working in education, Fergal Roche, chair of a seven-school MAT in Surrey and CEO of school leader and governor network The Key, notes how teachers used to turn up to class with notes to use in their teaching (2018). This is something that seems to have fallen out of fashion but that I have found useful in teaching new topics for A-level.

The problem with this approach is that it can lead to teachers staying just one page ahead in the textbook, whereas lessons for many subjects rarely work this way when synoptic links to other parts of the subject are common. In the example above, about teaching appropriate technology, I would need not only knowledge of this concept and examples like the Play Pump scheme, but also knowledge of aquifers and different forms of aid. This kind of knowledge is more likely to accrue through a more regular immersion in your subject.

One simple way to do this is to continue to read about your subject. However, the content in academic journals and books can feel very far removed from the subject at school level. The information needs to be recontextualised from an academic setting to a school one (Firth, 2018).

While research suggests that continuing professional development (CPD) programmes that consider both subject knowledge and subject-specific pedagogy can support teachers with developing subject expertise (Cordingley et. al., 2015), I have had no real school CPD input on subject knowledge in 14 years of teaching, because there are few agencies that can deliver it. This is where subject associations can play a pivotal role. Most have regular publications, with articles not only on teaching the subject but on improving the teacher's knowledge of the subject as well. For example, The Geographical Association have recently published articles on the changing ideas about tectonic movement and the implications for the classroom. Subject associations also offer training sessions and conferences, and there are an increasing number of subject-specific TeachMeet events being organised by teachers around the country.

Social media has certainly made developing subject knowledge easier than ever, with communities of teachers willing to share resources and discuss teaching difficult concepts. Most subjects have their own hashtags on Twitter, such as #TeamEnglish and #GeographyTeacher, and many have their own dedicated group chat sessions (for example, see Kaiser, 2018).

Conclusion

A teacher's subject knowledge is incredibly important. There are many things we can do to develop this subject knowledge ourselves and with the help of our colleagues, including:

1. Plan in time to develop your subject knowledge in the same way you would set aside time for marking or developing resources. Don't feel guilty about this time – the research shows that little else will improve your teaching as much.
2. Join a subject association and make the most of their resources and training opportunities. Many departments have a group membership but they are often underused.
3. Look for a wider community of teachers on social media, at conferences and at TeachMeets and join in. Ask lots of questions and share your own ideas.

REFERENCES

Christodoulou D (2014) *Seven Myths About Education*. London: Routledge.

Coe R, Aloisi C, Higgins S et al. (2014) *What Makes Great Teaching? Review of the Underpinning Research*. London: Sutton Trust.

Cordingley P, Higgins S, Greany T et al. (2015) Developing great teaching: Lessons from the international reviews into effective professional development. Teacher Development Trust. Available at: http://TDTrust.org/about/dgt (accessed 13 April 2018).

Firth R (2018) Recontextualising geography as a school subject. In: Jones M and Lambert D (eds) *Debates in Geography Education*. Oxon: Routledge, pp. 275–286.

Kaiser N (2018) Threshold concepts and cognition in science: #CogSciSci. *Impact* 2: 21–22.

Marsden B (1997) On taking the geography out of geography education: Some historical pointers. *Geography* 82(3): 241–52.

Roche F (2018) *Mining for Gold*. Woodbridge: John Catt.

Rosenshine B (2012) Principles of instruction: Research-based strategies that all teachers should know. *American Educator* 36(1): 12–19.

Willingham DT (2009) *Why Don't Students Like School?* San Francisco: Jossey-Bass.

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How multimedia can improve learning and instruction

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This article is based on an extract from a chapter in Dunlosky J and Rawson K (eds) (forthcoming February 2019) *The Cambridge Handbook on Cognition and Education*. New York: Cambridge University Press.

Over the past 30 years, educational and cognitive psychology have amassed encouraging evidence that human understanding can be improved substantially when we add appropriate graphics to text. In short, people learn better from words and pictures than from words alone. This article explores the potential of this *multimedia principle* for improving how people understand communications about academic content, as measured by their ability to take what they have learned and apply it to new situations (i.e. to solve transfer problems).

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Multimedia instruction

Multimedia instruction (or a multimedia instructional message) refers to a lesson containing both words and pictures, where the words can be in spoken form or printed form and the pictures can be in static form (such as illustrations, charts, graphs or photos) or dynamic form (such as animation or video). Multimedia instruction can be presented in books, in live slideshow presentations, in e-learning on computers, or even in video games or virtual reality.

In multimedia learning, pictures do not replace words, but rather work together with words to form an instructional message that results in deeper understanding. For example, consider a verbal description of how a bicycle pump works. After students listen to an explanation, they are not able to generate many useful answers to transfer questions such as the troubleshooting question, 'Suppose you push down and pull up several times but no air comes out. What could have gone wrong?' (Mayer and Anderson, 1991). However, if we add a simple animation depicting the movement of the handle, piston and valves in a pump, in sync with the narration, students are able to generate more than twice as many useful answers.

How the multimedia principle works

The cognitive theory of multimedia learning is based on three key ideas from cognitive science:

- Dual-channel principle: The human information processing system contains separate channels for verbal and pictorial information (Baddeley, 1992)
- Limited capacity principle: Only a few items can be processed in a channel at any one time (Baddeley, 1992)
- Active processing principle: Meaningful learning requires appropriate cognitive processing during learning, including attending to relevant information, mentally organising it into a coherent structure, and integrating it with relevant prior knowledge (Mayer, 2009).

Overall, in multimedia instruction, meaningful learning occurs when the learner selects relevant words and images from the multimedia message for further processing in working memory, mentally organises the words into a coherent structure (or verbal model) and the images into a coherent structure (or pictorial model), and integrates the verbal and pictorial representations with each other and with relevant prior knowledge activated from long-term memory.

The main challenge in teaching is to guide learners to engage in these processes, while not overloading their limited processing capacity in each channel of working memory. Designing effective multimedia instruction requires not only presenting the relevant material, but also guiding the learner's cognitive processing of the material.

Implications of the multimedia principle for the classroom

In attempting to apply the multimedia principle to practical educational venues such as classroom instruction, textbooks and online instruction, it becomes clear that some ways of incorporating graphics are more effective than others. **Table 1** lists 11 evidence-based principles for the design of multimedia instruction, with the median effect size based on published experiments comparing the transfer test performance of students who learned with the standard version of the lesson versus those who learned with an enhanced version that added the target feature, and the number of experiments showing a positive effect out of the total number of experiments.

Extraneous processing

The first five principles address the goal of reducing **extraneous processing** – cognitive processing during learning that does not support the instructional goal. Working memory capacity is limited, so if a learner allocates too much cognitive processing capacity to extraneous processing, there will not be enough cognitive capacity left to fully engage in essential processing (i.e. cognitive processing aimed at mentally representing the essential information in working memory) and generative processing (i.e. cognitive processing aimed at reorganising the material and integrating it with relevant knowledge activated from long-term memory).

The *coherence principle* is that people learn better when extraneous material is excluded (Mayer, 2009; Mayer and Fiorella, 2014). Extraneous material includes unneeded detail in graphics, background music, or interesting but irrelevant facts in the text. More learning occurs when the instructional message is kept as simple as possible.

The *signalling principle* is that people learn better when essential material is highlighted (van Gog, 2014). Highlighting of printed text can involve the use of colour, underlining, bold, italics, font size, font style or repetition. Highlighting of spoken text can involve speaking louder or with more emphasis. Highlighting of graphics includes the use of arrows, colour, flashing and spotlights.

The *spatial contiguity principle* is that people learn better when printed words are placed near to, rather than far from, corresponding graphics (Ayres and Sweller, 2014). Johnson and Mayer (2012) reported that students performed substantially better on transfer tests when they received integrated presentations (the words placed near the part of the graphic they describe) rather than separated presentations (the words presented as a caption at the bottom of the page or screen), even though the words and graphics were identical.

People learn better when printed words are placed near to, rather than far from, corresponding graphics

The *temporal contiguity principle* is that people learn better from a narrated lesson when the spoken words are presented simultaneously with the corresponding graphics (such as drawings, animation or video), rather than 'successive presentation', when the spoken words are presented before (or after) the graphics (Ginns, 2006).

The *redundancy principle* is that people learn better from narration and graphics than from narration, graphics and redundant text that duplicates the narration (Adesope and Nesbit, 2012).

Essential processing

The next three principles are aimed at managing **essential processing** (i.e. cognitive processing for mentally representing the essential material in working memory). When the material is complex for the learner, the amount of essential processing required to mentally represent the material may overload working memory capacity. In this case, the learner needs to be able to manage his or her processing capacity in a way that allows for representing the essential material.

The *segmenting principle* calls for breaking a multimedia lesson into manageable parts (Mayer and Pilegard, 2014). For example, rather than presenting a 2.5-minute narrated animation on lightning formation as a continuous presentation, break it into short segments and allow the learner to click to go to the next segment, enabling them to digest one step in the process of lightning formation before going on to the next one.

The *pretraining principle* calls for teaching students about the names and characteristics of key elements before presenting the multimedia lesson (Mayer and Pilegard, 2014). For example, before presenting a narrated animation depicting how a car's braking system works, students can be presented with a diagram of the braking system showing the key

TABLE 1

EVIDENCE-BASED PRINCIPLES FOR THE DESIGN OF MULTIMEDIA INSTRUCTION

Principle	Description	ES	No.
Principles for reducing extraneous processing in multimedia learning			
Coherence principle	Eliminate extraneous material	0.86	23/23
Signalling principle	Highlight essential material	0.41	24/28
Spatial contiguity principle	Place printed words near corresponding graphics	1.10	22/22
Temporal contiguity principle	Present corresponding narration and graphics simultaneously	1.22	9/9
Redundancy principle	Do not add printed onscreen text that duplicates narrated graphics	0.86	16/16
Principles for managing essential processing in multimedia learning			
Segmenting principle	Break lesson into manageable parts	0.77	10/10
Pretraining principle	Provide pretraining in names and characteristics of key elements	0.75	13/16
Modality principle	Present words in spoken form	0.76	53/61
Principles for fostering generative processing in multimedia learning			
Personalisation principle	Use conversational language	0.79	14/17
Voice principle	Present spoken text with an appealing human voice	0.74	5/6
Embodiment principle	Use humanlike gestures	0.40	13/13

ES = median effect size based on Cohen's d; No. = number of positive effects out of total number of comparisons.

parts, e.g. brake pedal, piston, wheel cylinders and brake shoes.

The *modality principle* is that people learn better from multimedia presentations when the words are spoken rather than printed (Low and Sweller, 2014), so the visual channel does not become overloaded by having to process both graphics and printed words.

Generative processing

The final three principles are intended to foster generative processing (i.e. cognitive processing aimed at making sense of the presented material). Even if cognitive capacity is available, learners may not be motivated to use it to process the material deeply. Social cues can help motivate learners to engage in deeper processing because people tend to want to understand what a communication partner is telling them. Thus, principles based on social cues are intended to make learners feel as if they are in a conversation with the teacher. This approach yields the newest of the multimedia design principles.

The *personalisation principle* is that people learn better from a multimedia lesson when the words are in conversation style rather than formal style (Ginns et al., 2013) – for example, presenting the words from a lesson on how the human respiratory system works in first and second person form (e.g. 'your lungs') rather than third person form (e.g. 'the lungs').

The *voice principle* is that people learn better from multimedia lessons involving spoken words when the narrator has an appealing human voice rather than a machine voice (Mayer, 2014).

The *embodiment principle* is that people learn better from multimedia lessons in which an onscreen agent or instructor uses humanlike gesture (Mayer, 2014). For example, Mayer and DaPra (2012) presented students with a narrated slideshow lesson in which an onscreen animated pedagogical agent stood next to the slide and either displayed humanlike gestures or did not move during the lesson. Students learned better when the onscreen agent used humanlike gestures.

Boundary conditions

Each of the 11 evidence-based principles has important boundary conditions, largely consistent with the cognitive theory of multimedia learning. Some principles may apply more or less strongly, or have weaker or stronger effects, depending on, for example, working memory capacity, level of prior knowledge and complexity of the material being presented.

Multimedia learning principles in practice

What happens when we combine these principles within the context of an actual classroom? Issa et al. (2013) compared how beginning medical students learned from a standard slideshow lesson or from a lesson in which the slides were modified based on multimedia design principles such as in **Table 1**. On a transfer test administered four weeks later, students in the modified group outperformed those in the standard group with an effect size of d = 1.17, even though the content was the same. This study, and similar ones (Harskamp et al., 2007; Issa et al., 2011), suggest that applying multimedia principles to the design of classroom instruction can greatly increase student learning.

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REFERENCES

Adesope OO and Nesbit JC (2012) Verbal redundancy in multimedia learning environments: A meta-analysis. *Journal of Educational Psychology* 104: 250–263.

Ayres P and Sweller J (2014) The split attention principle in multimedia Learning. In: Mayer RE (ed) *The Cambridge Handbook of Multimedia Learning* (2nd edition). New York: Cambridge University Press, pp.206–226.

Baddeley AD (1992). Working memory. *Science* 255: 556–559.

Ginns P (2006) Integrating information: A meta-analysis of spatial contiguity and temporal contiguity effects. *Learning and Instruction* 16: 511–525.

Ginns P, Marin AJ, Marsh HM (2013) Designing instructional text for conversational style: A meta-analysis. *Educational Psychology Review* 25: 445–472.

Harskamp EG, Mayer RE and Suhre C (2007) Does the modality principle for multimedia learning apply to science classrooms? *Learning and Instruction* 17: 465–477.

Issa, N et al., (2011) Applying multimedia design principles enhances learning in medical education. *Medical Education* 45: 818–826.

Issa N et al., (2013) Teaching for understanding in medical classrooms using multimedia design principles. *Medical Education* 47: 388–396.

Johnson C and Mayer RE (2012) An eye movement analysis of the spatial contiguity effect in multimedia learning. *Journal of Experimental Psychology: Applied* 18: 178–191.

Low R and Sweller J (2014) The modality principle in multimedia learning. In: Mayer RE (ed) *The Cambridge Handbook of Multimedia Learning* (2nd edition). New York: Cambridge University Press, pp. 227–246.

Mayer RE (2009) *Multimedia Learning* (2nd edition). New York: Cambridge University Press.

Mayer RE (2014) Principles based on social cues in multimedia learning: Personalization, voice, image, and embodiment principles. In: Mayer RE (ed) *The Cambridge Handbook of Multimedia Learning* (2nd edition). New York: Cambridge University Press, pp. 345–368.

Mayer RE and Anderson RB (1991) Animations need narrations: An experimental test of a dual-coding hypothesis. *Journal of Educational Psychology* 83: 484–490.

Mayer RE and DaPra CS (2012) An embodiment effect in computer-based learning with animated pedagogical agent. *Journal of Experimental Psychology: Applied* 18: 239–252.

Mayer RE and Fiorella L (2014) Principles for reducing extraneous processing in multimedia learning: Coherence, signaling, redundancy, spatial contiguity, and temporal contiguity. In: Mayer RE (ed) *The Cambridge Handbook of Multimedia Learning* (2nd edition). New York: Cambridge University Press, pp. 345–368.

Mayer RE and Pilegard C (2014) Principles for managing essential processing in multimedia learning: Segmenting, pretraining, and modality principles. In: Mayer RE (ed) *The Cambridge Handbook of Multimedia Learning* (2nd edition). New York: Cambridge University Press, pp. 379–315.

van Gog T (2014) The signaling (or cueing) principle in multimedia learning. In: Mayer RE (ed) *The Cambridge Handbook of Multimedia Learning* (2nd edition). New York: Cambridge University Press, pp. 263–278.

Using Cognitive Load Theory to improve slideshow presentations

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In recent years, the slideshow presentation has become so ubiquitous in our schools that it has become rare to walk into a lesson and not see one on display. However, teaching from a slideshow can either support or hamper learning, depending on the slideshow design.

In my English classroom, I use slideshows for a number of practical reasons:

- to present pre-prepared examples, models and images
- to provide permanent access to task instructions and success criteria
- to prompt me about what to cover next
- to share and store resources effectively and efficiently.

Unfortunately, the way that slideshows are sometimes designed – overflowing in a chaos of words and images – does not complement what we know about how people learn. Our working memory, which we use for language comprehension, problem-solving and planning, has a very small capacity. We can only hold on to a limited number of items at once – between three and five

Our working memory, which we use for language comprehension, problem-solving and planning, has a very small capacity

for young adults, depending on the difficulty of the task – and there are differences in capacity between individual people (Cowan, 2010). When the capacity of our working memory becomes overloaded, it becomes harder to transfer new information into long-term memory.

Susan E Gathercole and Tracy Packiam Alloway (2007, p. 7) note the stark differences in working memory capacity that can occur in the average class:

> *... in a typical class of 30 children aged 7 to 8 years, we would expect at least three of them to have the working memory capacities of the average 4-year-old child and three others to have the capacities of the average 11-year-old child which is quite close to adult levels.*

Cognitive Load Theory has developed from the work of Australian educational psychologist John Sweller (1994). It is based on understanding the types of information held in working memory at any one time. These are known as *intrinsic load*, *extraneous load* and *germane load* and, added together, make up the capacity of the working memory.

Intrinsic load is related to the inherent difficulty of the subject matter being learnt. It is influenced by how complex the material is and how much a student already knows about the topic. For example, 2 + 2 + 4 has less intrinsic load than 93 x 543, while understanding the workings of the human respiratory system has more intrinsic load than knowing where the lungs are situated in a human body.

Extraneous load is bad for learning because it can hinder the construction of long-term memories. It refers to any extra and unnecessary thinking that students have to do that does not contribute to learning. Unlike intrinsic load, extraneous load is related to how the subject material is presented rather than its inherent difficulty and, as teachers, we can either heighten or reduce its effect.

The third type of cognitive load, **germane load**, is desirable. It is the load placed on working memory that contributes directly to genuine learning – in other words, the nourishing and productive thinking that causes our students to form and consolidate long-term memories.

Therefore, a good slideshow presentation should:

- remain mindful of the intrinsic load of the task

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- reduce extraneous load
- increase germane load.

What follows are some very practical tips that I have been using in my lessons for doing just this:

Less is more. Reduce the amount of text and diagrams to as few as necessary, but no fewer. This will ensure that you do not overload your students' limited working memory capacity.

Ensure that labels are integrated into diagrams and ensure that information is presented in close physical proximity to related information. This way, students can look at text and images simultaneously. This helps to avoid the 'split-attention effect', which occurs when learners have to mentally integrate information by holding one thing in working memory while they search for another (Chandler and Sweller, 1992).

Avoid reading out text that is already written on the slide (unless you think that students are unable to read it independently). Studies have shown that you should avoid reading aloud text that is written on the board or a slide. This overloads working memory because students cannot process two types of language input simultaneously.

Remove distracting or superfluous images. Only use those that directly support learning, because unnecessary images create extraneous cognitive load.

Use images to support complex and conceptual ideas. The dual coding theory suggests that presenting language and images together enhances learning (Paivio, 1971).

If you intend to explain an image, it is best not to include written text at the same time (especially when you intend to be brief). Again, this can create extraneous load.

Never expect students to read something from the board while you are talking at the same time! It is not possible to split attention between both.

Reveal processes stage by stage on the same slide, rather than on consecutive slides. This way, students have a prompt to remind them of earlier stages and do not have to juggle too much information in working memory.

Remember that spoken words and slides are fleeting and transient and that your students' innate cognitive architecture means that they will be unable to hold on to them all at once. Slideshow handouts and shortened 'bursts' of teaching can reduce this problem.

REFERENCES

Chandler P and Sweller J (1992) The split attention effect as a factor in the design of instruction. *British Journal of Educational Psychology* 62(2): 233–246. Available at: https://onlinelibrary.wiley.com/doi/abs/10.1111/j.2044-8279.1992.tb01017.x.

Cowan N (2010) The magical mystery four: How is working memory capacity limited, and why? *Current Directions in Psychological Science* 19(1): 51–57.

Gathercole SE and Alloway TP (2007) *Understanding Working Memory: A Classroom Guide.* London: Harcourt Assessment.

Paivio A (1971) *Imagery and Verbal Processes.* New York: Holt, Rinehart and Winston.

Sweller J (1994) Cognitive load theory, learning difficulty and instructional design. *Learning and Instruction* 4: 293–312. Available at: http://coral.ufsm.br/tielletcab/Apostilas/cognitive_load_theory_sweller.pdf.

Leading without limits: The role of school culture in implementing evidence-based practices

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According to its last annual report, half of all senior leaders in England consult the Education Endowment Foundation's Teaching and Learning Toolkit to inform decision-making (EEF, 2018a). In just seven years, the Toolkit has become central to – and indeed driven (Coldwell et al., 2017) – evidence-based practice in schools here and overseas.

For an increasing number of school leaders, the initial answer to the question 'what works?' is 'ask the Toolkit'. The thematic presentation of areas of research and practice, which can be ranked according to the strength of the evidence (EEF, 2018b), the additional months' progress and indicative cost, offers 'best bets', based on what has and what has not worked. Importantly, it cannot provide guarantees that any given method will work.

The EEF's inception coincided with the launch of the Pupil Premium in 2011. The Toolkit was promoted as a practical and independent way of providing schools with empirical evidence to inform how they invested their Pupil Premium. Schools must publicly declare how they spend their Premium via a statement on their website. This creates an audit trail, where bodies internal and external to the school can assess the extent to which Pupil Premium spending has improved outcomes for disadvantaged pupils.

The Toolkit's assessment of particular approaches or specific (usually commercially available) intervention programmes is particularly helpful for the time-poor school leader, sat at her laptop trying to figure out how best to spend precious funds. If, for instance, she needs to improve reading in Key Stage 2, the Toolkit's links to the EEF's 'Promising Projects' page will indicate approaches and programmes found to be effective elsewhere, and under what circumstances. She will be conscious, too, of creating an audit trail to satisfy governors, Ofsted and other scrutineers of the cost-effectiveness of her decision-making.

Evidence, then, is potentially very valuable for schools, but it needs to be used intelligently. Our accountability culture can have an unintended distorting effect on the way in which school leaders engage with research. The promise of evidence-informed practices to resolve persistent problems raises expectations, but it still requires a high level of critical engagement on behalf of schools if it is to be successful in terms of raising standards.

Evidence: Limitations and context

A large part of the Toolkit's success is attributable to its accessibility and concision, but presenting complex research findings in this way involves a trade-off. Some researchers may be a little nervy about the nuance being stripped from their work, and concerned that the Toolkit oversimplifies matters. However, with a few clicks on the EEF website, one can easily access the underlying data and methodology. Despite this transparency, school leaders under pressure to narrow the

Our accountability culture can have an unintended distorting effect on the way in which school leaders engage in research.

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attainment gap are at risk of making cost-benefit judgments on the basis of a face-value encounter with the Toolkit. School leaders need time to invest in deepening their understanding of evidence, but also to recognise its limitations and, as importantly, consider evidence in the light of their own unique context.

Second to school leaders' question of 'what works?' is 'how much bang can I get for my buck?' Half of all senior leaders might use the Toolkit, but we do not know what proportion use it effectively – for example, to select a proven approach or programme to help improve the chances of successfully addressing a specific learning need for a particular group of pupils. Sometimes, the imperative to show impact predominates, and school leaders ask these questions in the opposite order. Reacting to, for example, a poor set of SATs results or an unfavourable Ofsted grading distorts the type of engagement with, and application of, research evidence that the EEF encourages, and so increases the likelihood of poor decision-making.

Superficial engagement with the Toolkit is also a risk in cases where schools abandon particular approaches. For instance, school leaders regularly tell me of counterparts in nearby schools who 'got rid of all their teaching assistants' after viewing the Toolkit's impact summary on TAs as 'high cost, low impact'. Cutting TAs is at variance to guidance based on empirical research that says schools should instead be making better deployment decisions about TAs – not getting rid of them (Webster et al., 2016).

To be fair to the EEF, it is aware of these risks (EEF, 2017). Furthermore, it is not just the EEF Toolkit that might prompt this sort of behaviour among school leaders; the presentational style of John Hattie's *Visible Learning* (2008) can provoke similar thinking. This is not a fault of the Toolkit or any other such resources. The risk lies in the accountability and financial pressures that constrict the time and space for school leaders to be curious and to relate evidence to their own context.

But there is a further possible unintended consequence of atomising educational approaches and innovations, and pitching them against one another in terms of impact. It can be easy to lose sight of how two or more interventions interact with one another, and how one can amplify or moderate the effect of others. For example, take two of the Toolkit's most popular strands: metacognition and self-regulation (low cost, high impact) and teaching assistants (high cost, low impact). We know that poor deployment of TAs can foster dependence and impede the development of pupils' independence skills; yet, trained and deployed more thoughtfully, TAs have the potential to support efforts to improve pupils' metacognitive traits and ability to manage their own learning (Webster et al., 2016).

The notion of the school or the classroom as an ecosystem has got somewhat lost in the 'what works' narrative. Much of this is prefigured in ›

Cartwright's (2011) argument that a similar situation has occurred in medicine. Educational interventions and approaches do not occur in isolation; they are interconnecting parts of an overall teaching and learning experience. Secondary schools that use setting, for example, reduce class sizes for lower-attaining groups, and deploy TAs in these classes; whereas classes for middle-attainers and higher-attainers are comparatively larger and do not contain TAs (Blatchford and Webster, 2018). Each of these structural factors (setting, class size and TAs) has its own discrete evidence base behind it, yet we know little of how they interact, and how they might be composed to optimise teaching and learning.

This is pertinent in the case of setting, class size and TAs (all Toolkit strands), because almost all schools adopt these approaches to some extent, but the evidence shows that their respective impacts on learning are disproportionately worse for disadvantaged pupils. When combined, these effects could be magnified. For example, experimental studies in the USA (Finn et al., 2000) and the UK (Blatchford et al., 2004) have found no differences in the outcomes for pupils in classes with TAs present, while research in the UK has found a negative effect of support from TAs on pupil learning, irrespective of class size, and that effect is greatest for lower-attaining pupils and those with special educational needs (Webster et al., 2010). The critically minded school leader might therefore reasonably conclude, perhaps counterintuitively, that low class size plus the presence of an additional adult (as a further class-size reduction measure) is more harmful for pupils in disadvantaged groups than just reducing the raw number of pupils in the room with only the teacher.

Putting research evidence into action

It is this approach to considering the interactions between different inputs that prompted Leading Without Limits (LWL). LWL is a professional learning programme for school leaders, which uses exposure to high-quality research as the basis for a forensic exploration of how evidence-based approaches can be implemented and actualised in

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schools and classrooms.

LWL is a partnership between Rosendale Research School and UCL Institute of Education, and is running over the 2018/19 school year. It explores key strategic areas of school organisation and pedagogy, including 'ability' labelling, setting, grouping and metacognition. It addresses head-on some of the most persistent and problematic structures that feature on the Toolkit, but for which there are few or no commercially available programmes. While each session majors on a particular theme, each one (for example, in-class grouping) is explored in the context of learning from previous sessions (in this case, the effects of 'ability' labelling and setting/streaming).

Another justification for LWL is that the operationalisation of evidence-based practice is often the under-discussed side of making 'what works' work. The principles and practices of putting research evidence into action (Sharples et al., 2018) inform and infuse LWL's coverage. But engaging with evidence meaningfully also requires a supportive culture. The first LWL session explored an essential principle of effective implementation: creating an environment and school culture within which new ways of doing things can take root and flourish. Choosing this as a starting point was a deliberate strategy, informed by the experiences of the LWL leads (Marc Rowland from Rosendale Research School and myself) of working directly with hundreds of schools. We regard school culture and leadership as strong determinants of how effectively and how widely evidence-based approaches are adopted and embedded, and thus how impactful they are.

A good indicator of whether a healthy implementation culture exists is the extent to which a school lives its values. Values underpin culture, and establishing a set of guiding values is one important way in which school leaders set the weather. Visitors may be greeted at reception by a colourful display showing the school's values; or they may be spelled out in huge letters around the site; or pinned up in every classroom as a clever acrostic. But, as Mary Myatt (2017) says, values are 'truly lived, not just laminated'.

When causation is not fully provable, researchers explore the full social and educational panorama to determine plausible reasons for correlations that their analyses may reveal. Leading Without Limits is an attempt to encourage and equip school leaders to apply this thinking to their evidence-based practice and decision-making. Curiosity about discrete areas of evidence is important, and the EEF and the Toolkit can take a lot of credit for providing school leaders with the means and impetus to initiate these kinds of discussions. But it is when connections are made between areas of research, when practitioners build an understanding of evidence in context, that they enhance the power and potential impact of their individual and overall decision-making.

The success of the evidence-into-practice movement, however, begins back in school, with leaders recognising the importance and influence of core values on school culture in informing and facilitating a positive and productive learning environment for staff and pupils.

REFERENCES

Blatchford P, Russell A, Bassett P et al. (2004) *The Role and Effects of Teaching Assistants in English Primary Schools (Years 4 to 6) 2000–2003: Results from the Class Size and Pupil–Adult Ratios Project. Final Report*. London: DfES. Available at: https://www.education.gov.uk/publications/eOrderingDownload/RR605.pdf (accessed 8 January 2019).

Blatchford P and Webster R (2018) Classroom contexts for learning at primary and secondary school: Class size, groupings, interactions and special educational needs. *British Educational Research Journal* 44(4): 681–703.

Cartwright N (2011) A philosopher's view of the long road from RCTs to effectiveness. *The Lancet* 377(9775): 1400–1401. Available at: https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(11)60563-1/fulltext (accessed 8 January 2019).

Coldwell M, Greany T, Higgins S et al. (2017) *Evidence-Informed Teaching: An Evaluation of Progress in England. Research Report*. London: DfE. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/625007/Evidence-informed_teaching_-_an_evaluation_of_progress_in_England.pdf (accessed 8 January 2019).

Education Endowment Foundation (2017) The Teaching and Learning Toolkit: What are the risks and how do we address them? Available at: https://educationendowmentfoundation.org.uk/news/the-teaching-and-learning-toolkit-what-are-the-risks-and-how-do-we-address/ (accessed 8 January 2019).

Education Endowment Foundation (2018a) Annual report 2018. Available at: https://educationendowmentfoundation.org.uk/public/files/Annual_Reports/EEF_-_2018_Annual_Report_print.pdf (accessed 8 January 2019).

Education Endowment Foundation (2018b) Evidence strength. The EEF 'padlock' rating. Available at: https://educationendowmentfoundation.org.uk/evidence-summaries/about-the-toolkits/evidence-strength/ (accessed 8 January 2019).

Finn JD, Gerber SB, Farber SL et al. (2000) Teacher aides: An alternative to small classes? In: Wang MC and Finn JD (eds) *How Small Classes Help Teachers Do Their Best*. Philadelphia, PA: Temple University Center for Research in Human Development, pp. 131–174.

Hattie J (2008) *Visible Learning*. Oxon: Routledge.

Myatt M (2017) Walking the talk. In: Mary Myatt. Available at: http://www.marymyatt.com/blog/2017-12-09/walking-the-talk (accessed 8 January 2019).

Sharples J, Albers J and Fraser S (2018) Putting evidence to work: A school's guide to implementation guidance report. Available at: https://educationendowmentfoundation.org.uk/tools/guidance-reports/a-schools-guide-to-implementation/ (accessed 8 January 2019).

Webster R, Blatchford P, Bassett P et al. (2010) Double standards and first principles: Framing teaching assistant support for pupils with special educational needs. *European Journal of Special Needs Education* 25(4): 319–336.

Webster R, Russell A and Blatchford P (2016) *Maximising the Impact of Teaching Assistants: Guidance for School Leaders and Teachers* (2nd edition). Oxon: Routledge.

What is the best way to motivate students in your subject?

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Motivation is a complicated beast. Traditionally broken into intrinsic and extrinsic types, students may be motivated by a whole host of competing and intertwined factors. The academic literature varies widely on these definitional terms and how they are measured (Garon-Carier, 2015; see also Didau and Rose, 2016). This is further confounded by a gap between what people believe and what they actually do. For example, a recent and ongoing study into student attitudes to science education found that many students think that science is important and valuable, but do not wish to study it themselves (DeWitt, 2017).

Schools and teachers insert themselves into this cacophonous mix with often confusing and unpredictable results. For instance, a recent large-scale study of attendance interventions found that in schools where students were awarded for 100 per cent attendance, the attendance actually worsened over time. The researchers posit that social pressures (nobody wants to be 'that' student) can affect student motivation to attend. Furthermore, by rewarding 100 per cent, the schools were potentially signalling to students that actually less than 100 per cent was expected, and 100 per cent was above expected, worsening student motivation to attend (Robinson et al., 2018).

In curricular studies, some urge that content should be tailored to the students'

lived experiences in order to boost motivation. However, such a position can betray the 'power' of our subjects, limiting students and failing to open their minds to broader horizons and cultural treasures (Young, 2018). Additionally, such ideas can be difficult to implement – students have a curriculum to follow, and lived experiences aren't always going to be relevant.

An interesting avenue of pursuit relates to the relationship of student ability to long-term motivation. Ryan and Deci's seminal research into Self-Determination Theory (Ryan and Deci, 2000) argues that a vital component of individual motivation is competence. For example, giving people encouraging feedback on their performance increases their motivation: the experience of competence, of being good at something, boosts motivation. Garon-Carier et al. (2015) devised an experiment to test this idea. Defining intrinsic motivation in mathematics as engagement and interest in that subject, they found that motivation at the age of seven was no predictor of performance in mathematics some years later. However, performance at the age of seven *did* predict motivation some years later. Noting dissenting evidence, the researchers concluded that student performance – or competence – strongly affects whether or not they find interest in mathematics in the years to come.

Recently replicated (Nuutila et. al, 2018), this experiment suggests that teachers and schools should be aware that one of the most powerful ways to ensure students become motivated in their subjects is through improving their competence in that subject. As such, it may be more important for teachers to think about the best techniques to improve student performance, rather than techniques to increase their short-term engagement or interest.

An interesting case for discussion could be the role of 'drill', or extensive independent practice. Often derided as 'drill and kill' techniques (see Little, 2016), extensive silent, independent practice can be considered boring and demotivating and substituted for 'engaging' or 'fun' activities. This jars with the evidence base, which generally supports extensive individual practice (Willingham, 2010).

One of the most powerful ways to ensure students become motivated in their subjects is through improving their competence in that subject

Arguing for an appropriation of the phrase 'to drill and thrill', maths teacher Dani Quinn (2017) argues that extensive and carefully designed drill can lead students to feel a sense of success. An interesting comparison here is retrieval practice. It is well known that low-stakes quizzing is a highly effective tool for leveraging long-term memory (Firth et al., 2017), but it is worth noting that in the seminal studies on the topic, participants who undertook retrieval practice actually reported lower confidence in their abilities than those who undertook less effective memory activities, such as rereading or highlighting (Roediger and Butler, 2011). In the short term, challenging activities like retrieval practice can leave students feeling demotivated, or lacking in 'competence'. In the long term, however, such activities are far more likely to bring improved student performance and, with it, a sense of competence and motivation.

The flip side of this is also true. Nuthall's research (2007) revealed that students are most engaged when involved in work that carries minimal cognitive demand. Many activities touted as 'fun and engaging' do not adequately challenge students. As such, activities that appear beneficial in the short term are perhaps less so in the long term, and ones that appear ineffective in the short term may be highly effective in the long term.

In summary, motivation remains a complicated beast. But teachers should know that the day-to-day cycle of expert teaching – explain, practice, review – is a potential winner for building long-term interest and motivation.

REFERENCES

DeWitt J (2017) Inspiring the next generation of scientists. *Education in Chemistry*. Available at: https://eic.rsc.org/feature/inspiring-the-next-generation-of-scientists/3007626.article (accessed 21 November 2018).

Didau D and Rose N (2016) *What Every Teacher Needs to Know About … Psychology*. Woodbridge: John Catt.

Firth B, Smith M, Harvard B et al. (2017) Assessment as learning: The role of retrieval practice in the classroom. *Impact* 1: 18–21.

Garon-Carrier G, Boivin M, Guay F et al. (2015) Intrinsic motivation and achievement in mathematics in elementary school: A longitudinal investigation of their association. *Child Development* 87(1): 165–175.

Little G (2016) The drill and kill routine of improving test scores in exam factories hangs like dark, oppressive cloud over primary schools. *TES News*. Available at: https://www.tes.com/news/drill-and-kill-routine-improving-test-scores-exam-factories-hangs-dark-oppressive-cloud-over (accessed 21 November 2018).

Nuthall G (2007) *The Hidden Lives of Learners*. Wellington, New Zealand: NZCER Press.

Nuutila K, Tuominen H, Tapola A et al. (2018) Consistency, longitudinal stability, and predictions of elementary school students' task interest, success expectancy, and performance in mathematics. *Learning and Instruction* 56: 73–83.

Quinn D (2017) Drill and Thrill. In: Until I know better. Available at: https://missquinnmaths.wordpress.com/2017/03/16/drill-and-thrill/ (accessed 21 November 2018).

Robinson CD, Gallus J, Lee MG et al. (2018) The demotivating effect (and unintended message) of retrospective awards. HKS Faculty Research Working Paper Series. Available at: https://scholar.harvard.edu/files/todd_rogers/files/the_demotivating.pdf (accessed 14 January 2019).

Roediger H and Butler A (2011) The critical role of retrieval practice in long-term retention. *Trends in Cognitive Sciences* 15(1): 20–27.

Ryan R and Deci E (2000) Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist* 55(1): 68–78.

Willingham D (2010) *Why Don't Students Like School?* San Francisco, CA: Jossey-Bass.

Young M (2018) A knowledge-led curriculum: Pitfalls and possibilities. *Impact* 4: 1–4.

Building learning culture through effective uses of group work

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The literature on group work indicates pros and cons to its use in the classroom. By looking at mechanisms of group failure and success and then linking these to concrete practices, we highlight some important boundary conditions involving goal difficulty, how goals are set and feedback, which practitioners may find helpful to know about before building group work into the learning culture of their classrooms.

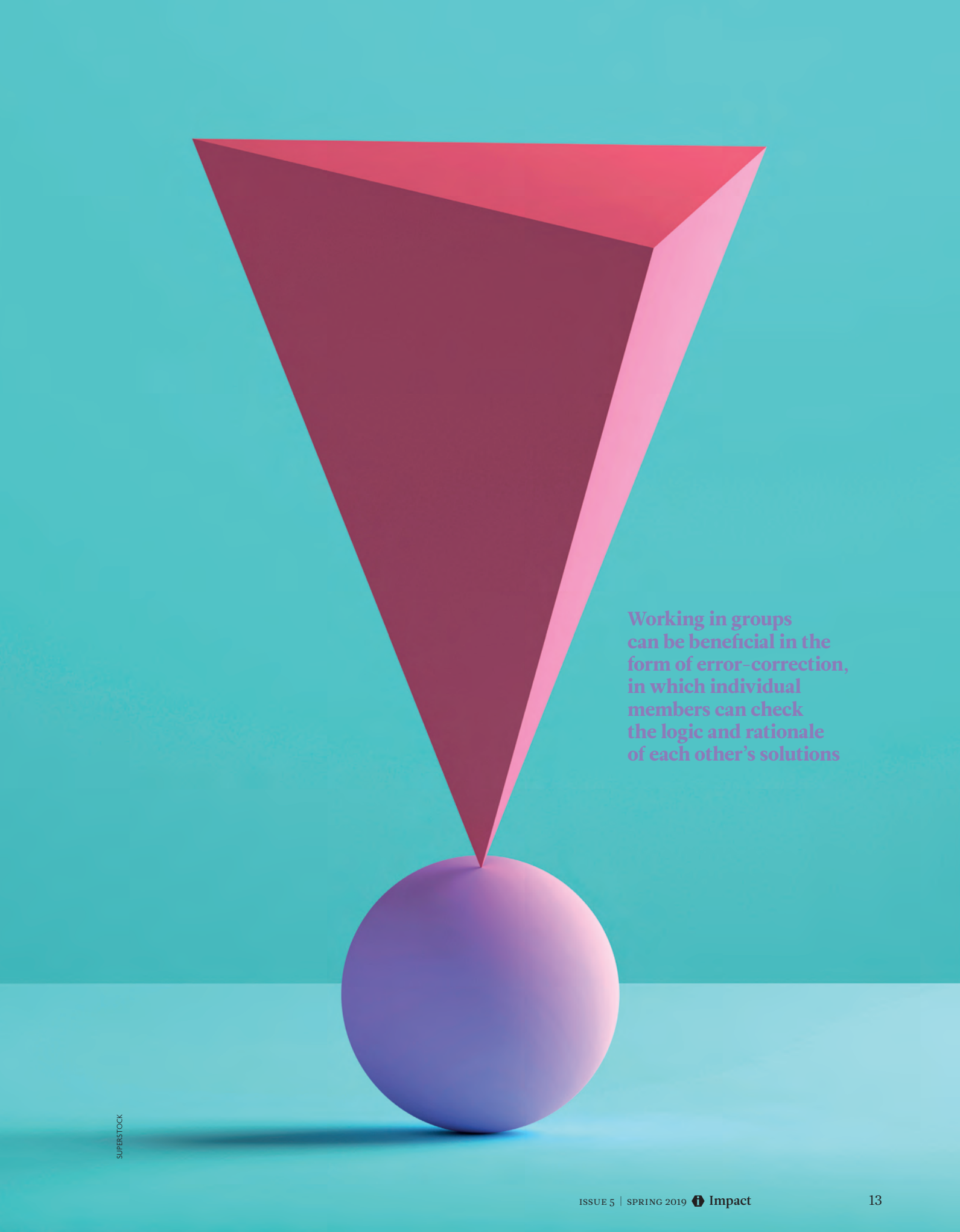
In a review, Nokes-Malach et al. (2015) highlight how several mechanisms underpin collaborative work, and describe how these mechanisms can determine group-work success or failure. They define collaboration as meaning active engagement and interaction among group members to achieve a common goal, and this will serve as our definition.

Nokes-Malach et al. (2015) go on to review numerous mechanisms of group failure and success, divided into cognitive and social mechanisms. On the *cognitive* failure side, we can see the cognitive costs of coordinating and collaborating. Every teacher knows the scenario where coordination between group members is so effortful that it would have been simpler to do the task individually. The practical implications for the practitioner are that in these situations, choosing collaborative tasks for your students is probably not the best course of action. Nokes-Malach et al. (2015) then highlight other cognitive disadvantages to groups; these can manifest themselves through losing one's train of thought because of paying attention to other group members, sometimes referred to as retrieval strategy disruption. Finally, production blocking can take place, with missed retrieval opportunities, as group members must wait their turns while another person is talking.

There are also *social* mechanisms that can lead to group failure. Perhaps the best known social mechanism is 'social loafing', which can happen when group members do not contribute optimally because they think other group members will do the work. Fear of evaluation from other group members can also lead to group failure. Other social pitfalls to group work include a tendency for group members to defer to the highest-status person in the group, regardless of idea merit (Cohen, 1994). Lastly, there is some evidence that working in groups can sometimes be detrimental to students with learning support needs (Baines et al., 2015), and very strong individual performers may not perform optimally in group work as they reduce their output to fit in with the group (Campbell et al., 2017). 'Tall poppies' syndrome can also be an issue for high performers in groups, and they can attract resentment and subtle undermining from the rest of the group (Campbell et al., 2017).

However, there also are cognitive and social processes that can lead to group-work success. Starting with cognitive processes, one cognitive mechanism, called cross-cueing, posits that group members can use their collective knowledge about a problem-solving task or domain to cue each other's prior knowledge when trying to think of ideas, strategies and solutions. Put simply, cross-cueing would suggest that individual performance benefits from the group in a strategic planning sense above and beyond what would be the case for individuals. Likewise, another cognitive mechanism suggests that the collective knowledge of the group can surpass that of the individual members: learners in a group have complementary knowledge or expertise, which means that different members of the group may contribute different components of the overall solution. Both of these mechanisms seem to relate to an increase of working memory resources (Kirschner et al., 2009).

Working in groups can be beneficial in the form of error-correction, in which individual members can check the logic and rationale of each other's solutions. The act of re-exposure, where individual members of a group are given new opportunities to learn content that the other group members recall, can lead to improvements in their own individual learning. This can be seen as a variant of more general relearning through the



Working in groups can be beneficial in the form of error-correction, in which individual members can check the logic and rationale of each other's solutions

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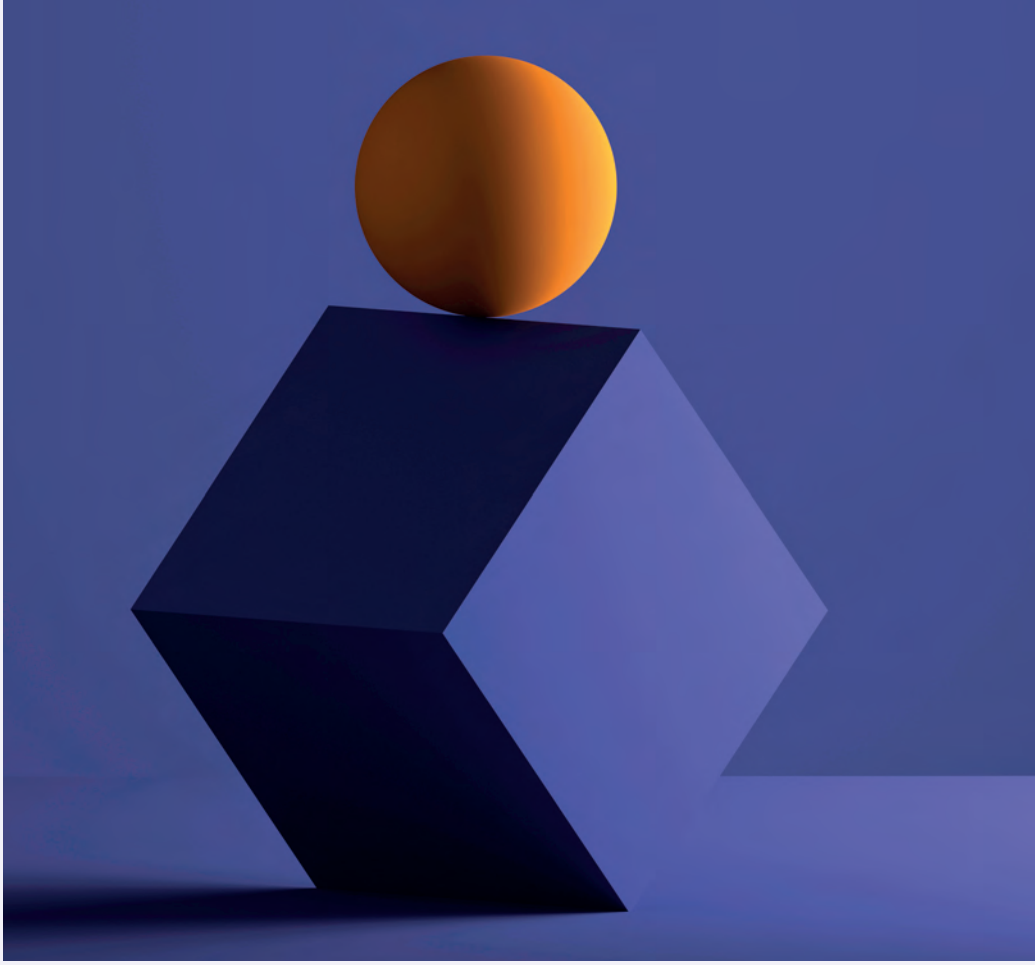

retrieval practice effect. Furthermore, from a social perspective, watching other people can lead to observational or vicarious learning, one of the key principles derived from Bandura's 'social learning theory' (1977). Nokes-Malach et al. (2015) mention how collaborative learning has also been hypothesised to increase individual motivation and engagement. However, critical for collaborative success are processes related to the joint management of attention and the construction of common ground among group members. Finally, the process of negotiating multiple perspectives can lead to learning and to the acquisition of more abstract representations than group members would acquire alone. Taken together, such mixed findings suggest both caution and promise for instructors. It is towards those mechanisms that can enhance the efficacy of group work that we now turn.

Perhaps the single name most associated with research into group work in education is Slavin (2010), who argues that effective group work requires two criteria: a shared group goal and individual accountability. While Slavin (2010) hints strongly that the group goal – and therefore, logically, individual goals – should be a learning goal rather than a performance goal, Slavin does not go into detail on the mechanics behind goal-setting. To address this gap, we turn to organisational psychology, and in particular Locke and Latham's 'Goal-Setting Theory' (2006). Highly practical in nature, goal-setting theory is useful for the practising teacher as it is a fully developed theory of motivation and task performance, fascinatingly counter-intuitive in its prescriptions. Locke and Latham's key idea is that clear goals are more motivating and liable to lead to greater performance than a simple 'do your best' instruction under most conditions. The counter-intuitive aspect is that goals are more motivating the more challenging they are, though they still need to be achievable (Locke and Latham, 2006). A secondary idea of particular importance is that there are broadly two types of goals: learning goals and performance goals. For particularly complex tasks, a high specific learning goal or any goal that implies an element of exploration is more appropriate than a performance goal such as 'get an A-grade' (Seijts and Latham, 2005). Both types of goal can be usefully combined. Importantly for our purposes, these principles of goal-setting generally apply equally well to group work (Kramer et al., 2013).

These major principles of goal-setting generally apply to collaborative tasks but there are some important moderators. Firstly, it is important that goal commitment is in place or you are unlikely to reap many rewards from goal-setting, and obviously it is much harder to get a group of disparate individuals committed to a goal than an individual. Again counter-intuitively, goal-setting theory suggests a solution: imposed goals can be equally motivating for group members as long as a reason is given and accepted (Latham, 2007). Lastly, there can be clashes between individual goals and the overall team goal, and so it is important that individual goals are designed carefully to prevent this happening (Kramer et al., 2013).

So, drawing things together, what advice does the literature offer for the practising teacher in their use of group work? We suggest the following ideas as fruitful to experiment with:

- Process over product: Before setting group work, tell the group that they will also be expected to critique their own performance against their progress towards the goals, during and not only after the task. Allocate time for this. (Derived from Kramer et al., 2013.)
- Learning over performance: Use learning goals rather than performance goals (or both rather than performance goals alone). Learning goals will typically use stems such as, 'Discover three to four ways of…' or 'Investigate how best to…' (Derived from Seijts and Latham, 2005.)

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- Set a high bar: Ensure learning goals are specific and challenging for the group and for individual members. (Derived from Seijts and Latham, 2005.)
- Avoid unhealthy competition: Goals are powerful and can have negative side effects; avoid this by ensuring that individual goals for group members are not in competition with the group goal. (Derived from Kramer et al., 2013.)
- Be kind to one another: Establishing norms for group work and how students interact with each other, to ensure that your class culture is as positive as possible, is never time wasted. Be sure to stick to the norms and explicitly praise students who adhere to positive norms. (Derived from Kramer et al., 2013.) Garmston's seven norms are one possible starting point for developing norms that teachers can customise over time to suit their own classes (Garmston and Wellman, 2016).
- Small is beautiful: Keep group sizes small to minimise free riding; two to four is probably best for most tasks. (Derived from Nokes-Malach et al., 2015.)
- Explicitly model: Include positive and negative examples of goals at the initial preparation stage, especially if you plan to have the students construct their own goals. (Derived from Kramer et al., 2013.)
- The power of persuasion: Build group commitment to the goal by explaining why the goal is important. Imposed goals are also motivating if reasons are given. (Derived from Latham, 2007.)
- Process feedback: Ensure that you are giving feedback to groups during the process and not just at the end, and that this feedback is directly related to the final goal. Process feedback is essential for successful group work as it will allow groups to adjust performance and processes midstream. (Derived from Kramer et al., 2013.)
- Structure feedback around questions: It is a good idea to structure the mid-task feedback around questions to ensure that the group learns from each other. Consider asking questions related to progress towards the group goal, progress towards individual goals, and how the group is performing against the group norms. (Derived from Kramer et al., 2013.)
- Choose tasks carefully: Make sure that the task would not be better done individually. If you're not sure, then a trial run, 'blockbusters style', with some individuals and teams attempting the same task, might work. You can adjust the task depending on the trial results. (Derived from Nokes-Malach et al., 2015.)

As we have seen in exploring some of the evidence for and against including group work as part of a classroom and school learning culture, the participants, nature of the task, feedback, group cultural norms and types of goal are all important factors that can make or break group work. Or, to put it another way, group work, as with most things in education, is neither intrinsically good nor bad; it really just depends on how you use it.

REFERENCES

Baines E, Blatchford P and Webster R (2015) The challenges of implementing group work in primary school classrooms and including pupils with special educational needs. *Education 3–13* 43(1): 15–29.

Bandura A (1977) *Social Learning Theory*. Englewood Cliffs, NJ: Prentice Hall.

Campbell EM, Liao H, Chuang A et al. (2017) Hot shots and cool reception? An expanded view of social consequences for high performers. *Journal of Applied Psychology* 102(5): 845–866.

Cohen EG (1994) Restructuring the classroom: Conditions for productive small groups. *Review of Educational Research* 64(1): 1–35.

Garmston RJ and Wellman BW (2016) *The Adaptive School: A Sourcebook for Developing Collaborative Groups* (3rd edition). Lanham, MD: Rowman and Littlefield Publishers.

Kirschner F, Paas F and Kirschner P (2009) A cognitive load approach to collaborative learning: United brains for complex tasks. *Educational Psychology Review* 21(1): 31–42.

Kramer WS, Thayer AL and Salas E (2013) Goal setting in teams. In: Locke EA and Latham GP (eds) *New Developments in Goal Setting and Task Performance*. New York: Routledge, pp. 287–310.

Latham GP (2007) *Work Motivation*. London: Sage Publications.

Locke EA and Latham GP (2006) New directions in Goal-Setting Theory. *Current Directions in Psychological Science* 15(5): 265–268.

Nokes-Malach TJ, Richey JE and Gadgil S (2015) When is it better to learn together? Insights from research on collaborative learning. *Educational Psychology Review* 27(4): 645–656.

Seijts GH and Latham GP (2005) Learning versus performance goals: When should each be used? *Academy of Management Perspectives* 19(1): 124–131.

Slavin RE (2010) Co-operative learning: What makes group-work work? In: Dumont H, Istance D and Benavides F (eds) *The Nature of Learning: Using Research to Inspire Practice*. Paris: OECD Publishing, pp. 161–178.

Community curriculum-making: Mixing the 'local' with the National Curriculum

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Principles of community curriculum-making

Most people will be familiar with the African proverb that 'it takes a village to raise a child'. Hold that thought. There are a range of pressing issues facing society in 2019. These are well-represented in the United Nations Sustainable Development Goals (www.un.org/sustainabledevelopment/sustainable-development-goals/), which include:

- affordable and green energy
- sustainable cities and communities
- good health and wellbeing
- climate action.

While there are long-term trends upwards in GCSE and A-level results, for which schools are highly accountable and should take much credit, it is debatable whether the current curriculum is preparing young people for such challenges. Our argument is that where there are spaces to do so, there is a strong logic in using the principles of community curriculum-making (CCM). CCM is a variant of project-based learning (PBL), reflecting a number of other influences. The first of these influences is engagement. Engagement is a critical concept in education, as it indicates intrinsic motivation. Lawson and Lawson (2013, p. 433) present it as the 'conceptual glue that connects student agency (including students' prior knowledge, experience, and interest at school, home and in the community) and its ecological influences (peers, family and community) to the organisational structures and cultures of school'. If students are not engaged, it suggests that something has become unhinged in this set of relationships and that in some respects the curriculum has failed. The consequences are evident in England in pupils' instrumental approaches to school (Hufton et al., 2002) and disengagement (Kelly, 2009).

The second influence is 'area-based curriculum' (Thomas, 2012), which aimed to develop partnerships between schools and local organisations in order to develop a curriculum that was:

- **about** a place: making use of local context and resources to frame learning
- **by** a place: designed by schools in partnership with other local stakeholders
- **for** a place: meeting the specific needs of children and local communities.

This is not to argue that curriculum turns its back on global issues, but that there is a real effort to connect to place. A third influence is service learning

Engagement is a critical concept in education, as it indicates intrinsic motivation

(Butin, 2010), which sees students doing work of value to the wider community (for a place), a principle in operation in the National Citizen Service (www.ncsyes.co.uk/education). Other significant influences are 'Funds of Knowledge' (Moll et al., 1992), developed in the US to help bridge the cultural gap between formal education and the cultural knowledge of Latin American migrants, and role-modelling, where school staff and community volunteers offer out-of-school or extra-curricular activities. When students engage with adults in such roles, they increase their social capital and develop social competence, which informs their school engagement and academic performance (Stanton-Salazar, 2001). There is much synergy between CCM and the Cambridge Primary Review (2009, p. 19), which aimed to empower children to 'manage life and find meaning in the 21st century' by becoming an educated person with a focus on wellbeing, empowerment, engagement and autonomy. In practice, the Broomley Bee Project embodies many of these influences, where a class of Year 4 children worked with a wide range of professionals to research the threats to pollinating insects, investigated bee-keeping and trialled methods for improving habitats for pollinators (McGrane et al., 2017).

Planning CCM

While many schools do have links with the local community, CCM goes further and makes interaction with community a principle of curriculum development. With such a principle, a school would explicitly create and continuously update a record of useful contacts in relation to particular topics and/or subjects. Obvious topics might include local history/heritage, wildlife, STEM, health and medical services, food, arts and culture, energy, ageing and religious communities. Curriculum-planning over a key stage ›

would map the local and regional locations visited or focused on, and the school would have a list of the venues for showcasing students' work. There is a sense in which the school is giving back to the community (service learning) and we have evidence of the powerful effect on community participants of contributing to the education of the next generation (McGrane et al., 2017). Although there are specialists in the community who can provide expert knowledge, there is also great scope for people with interesting roles, hobbies or experience to be interviewed or 'hot-seated'. In consequence, your choice of countries to study in geography could reasonably be determined by the foreign nationals who are available to talk about their home country and/or provide feedback on the students' analysis of their country of origin. CCM is a mindset, and other obvious moves include using the whole staff (i.e. non-teaching) as a source of valuable contacts and publishing topics in advance and asking parents/carers for contacts. In some communities, there may be hesitation and a lack of confidence from families, so be prepared to work on this over time.

There is an increasing number of frameworks and guidance (Patton and Robin, 2012) to support planning of community-related projects, such as a model developed in Australia by two primary headteachers (Kenna and Millott, 2017), which is organised around a hierarchy of questions (see **Figure 1**). In the early days of establishing a CCM culture, the advantage of the hierarchy is that it provides structure while maintaining the spirit of a driving question.

FIGURE 1:
HIERARCHY OF QUESTIONS (ADAPTED FROM KENNA AND MILLOTT, 2017)

Question	Example	Comments
1. The hook question	What does it take to run a half-marathon? (Oriented to science, design technology and PE)	The question to start thinking and initial discussion – two meanings of 'run'!
2. Collective knowledge-gathering question	What things do you have to know/think about to answer the hook question effectively?	Questions that can be investigated using books, archives, people and the internet. They will have mainly factual answers that attend to subject knowledge.
3. Forming an opinion	Why do people 'run' half-marathons (and more)?	A debating question – for which everyone can have a reasoned opinion.
4. Deeper question	What would our half-marathon look like based on what we know?	A question that challenges – and can also draw in parents and wider community.
5. Applied/problem-solving question	Can we organise a race, applying some of what we know?	The question that generates the product to the enquiry/project.

Benefits

Earlier sections have suggested some of the benefits, but to clarify, CCM can help with a number of school agendas:

- the development of a more localised, distinctive curriculum as opposed to a uniform national curriculum
- addressing the 'Gatsby benchmarks for good careers guidance' (Gatsby Foundation, 2014)
- promoting engagement, collaborative and independent learning, the use of technology, and social mobility
- developing stronger links with parents and the local and wider community.

Perhaps of most significance is the powerful effect on identity, aspiration and self-concept of students that can result from increased exposure to social and cultural capital

Perhaps of most significance is the powerful effect on identity, aspiration and self-concept of students that can result from increased exposure to social and cultural capital, captured in our tagline for CCM: 'Going Places, Meeting People and Doing and Making Things' (see Leat, 2017).

Challenges

One of the intriguing questions around CCM is 'who or what is community?', to which there is no neat answer, but certainly community extends beyond the few miles around the school and can reach any part of the globe via digital communication.

There are three main challenges in planning. The first comes from needing to plan with a community partner and deciding on roles and responsibilities in the planning and teaching. There is a clear need here for brokerage (see Leat and Thomas, 2016; 2018) – someone from inside or outside the school who can help build relationships and address some of the issues in the other challenges. The second challenge comes from breaking the mould created by the usual equation of one teacher and 20 to 30 students/pupils in one classroom or teaching space. Different spaces and locations, timings and groupings may be required, which can be highly disruptive to school systems. The

third challenge comes from needing to be more flexible, moving away from tightly teacher-controlled lessons and towards projects in which pupils take more responsibility. Furthermore, the powerful learning in many CCM projects does not neatly fit an objectives-led planning model, as it is common for learning outcomes to vary considerably between individuals.

Research possibilities

If your school is new to using PBL, a good starting point is to investigate your (and colleagues') practice and what your students are thinking and feeling. Action research and professional inquiry are fitting. Some useful research questions would include:

- How and when should subject instruction be used in CCM projects?
- How do students respond to adults other than teachers?
- Do students talk to their parents and peers about the work?
- Do the CCM projects have an impact on identity, engagement, self-concept or motivation?

Our work is in North East England, centred on Newcastle. Our current project, funded by the Edge Foundation, will generate 30 CCM projects using university, employer and other community resources, documented to allow other schools to adapt and use them. These projects and others like them provide a vital opportunity for a wider community to support the education of future citizens – the curriculum is, after all, about more than passing exams; it is equally about allowing young people to develop their human capability. In our view, it does take a community to educate a child/student.

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REFERENCES

Butin D (2010) *Service-Learning in Theory and Practice: The Future of Community Engagement in Higher Education*. New York, NY: Palgrave Macmillan.

Cambridge Primary Review (2009) *Introducing the Cambridge Primary Review*. Cambridge: Cambridge University.

Gatsby Foundation (2014) Good career guidance. Available at: https://www.gatsby.org.uk/uploads/education/reports/pdf/gatsby-sir-john-holman-good-career-guidance-2014.pdf (accessed 25 March 2019).

Hufton NR, Elliott JG and Illushin L (2002) Educational motivation and engagement: Qualitative accounts from three countries. *British Educational Research Journal* 28(2): 265–289.

Kelly S (2009) Social identity theories and educational engagement. *British Journal of Sociology of Education* 30(4): 449–462.

Kenna P and Millott B (2017) Adapting self-organised learning environments to primary schools in Australia. In: Leat D (ed) *Enquiry and Project Based Learning: Students, School and Society*. Abingdon: Routledge, pp. 108–127.

Lawson M and Lawson H (2013) New conceptual frameworks for student engagement. Research, policy, and practice. *Review of Educational Research* 83(3): 432–479.

Leat D (ed) (2017) *Enquiry and Project Based Learning: Students, School and Society*. Abingdon: Routledge.

Leat D and Thomas U (2016) Schools and partners' guide to community curriculum making through enquiry and project based learning. Newcastle University: Research Centre for Learning and Teaching/ESRC. Available at: http://www.ncl.ac.uk/media/wwwnclacuk/cflat/files/Community%20Curriculum%20Making%20guide.pdf (accessed 25 March 2019).

Leat D and Thomas U (2018) Exploring the role of 'brokers' in developing a localised curriculum. *Curriculum Journal* 29(2): 201–218.

McGrane J, Halliday J and Moore S (2017) The Broomley Bee Meadow Project. In: Leat D (ed) *Enquiry and Project Based Learning: Students, Schools and Society*. Abingdon: Routledge, pp. 171–192.

Moll LC, Amanti C, Neff D et al. (1992) Funds of knowledge for teaching: Using a qualitative approach to connect homes and classrooms. *Theory into Practice* 31(2): 132–141.

Patton A and Robin J (2012) *Work That Matters – The Teacher's Guide to Project Based Learning*. London: Paul Hamlyn Foundation.

Stanton-Salazar RD (2001) *Manufacturing Hope and Despair: The School and Kin Support Networks of US-Mexican Youth*. New York: Teachers College Press.

Thomas L (2012) Area-based curriculum. Available at: https://www.thersa.org/action-and-research/rsa-projects/creative-learning-and-development-folder/area-based-curriculum/ (accessed 20 June 2014).

Starting with

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At the heart of the British-American author Simon Sinek's book *Start with Why* is the claim that the best organisations appreciate why they do something, as well as being able to articulate what they do and how they do it (Sinek, 2009). This idea became central to our methodology as a school, asking why we do anything and everything that we do to best serve our stated purpose: to equip our students to work for the positive transformation of our society.

I work in an environment where many of the 'best bets' now highlighted by evidence-based practice – high expectations, expert teacher subject knowledge and more – have been part of our school culture since its foundation. We are convinced that we exist to aid all of the students in our care to make the best possible progress, and to ensure that our curriculum provides them with the knowledge, skills and cultural capital needed to thrive in our society. Yet as we reflect, we are keenly aware that there are still gains to be made in all of these areas.

Why engage with evidence?

How do you start to move an established and successful school culture towards a more explicitly evidence-based approach? My experience has been that the best place to start is again with the question of why? Gary Jones (2018a) suggests comparing evidence-based education with evidence-based medicine; once you imagine yourself across the desk from a doctor whose practice is not grounded in evidence, you're a long way towards finding an answer.

There's a challenge, though, in presenting anything that is perceived as being new. A key step that we have taken is to express that we are not saying to staff who are already working exceptionally hard that they must work even harder.

Despite the concerning trend to narrow the curriculum for some subgroups of students, we have a moral responsibility to convey substantial, discipline-specific knowledge to all students

Instead, we are asking, 'Are you working in the ways that will most enhance your students' learning?' When we find practices that do not reap the gains that they should in student learning, we are able to say to staff, 'Work less, work smarter!'

Evidence and our curriculum

The draft Ofsted framework has brought into sharper focus the issue of curriculum, both for us and for the wider profession. In Issue 4 of *Impact*, Christine Counsell suggests, 'Curriculum is all about power. Decisions about what knowledge to teach are an exercise of power and therefore a weighty ethical responsibility.' (Counsell, 2018, p. 6)

This poses for all of us a difficult question: to what extent have we viewed our curricula as a decision or an exercise of power? Or have we just taught what we have taught because that's what you teach? Much of the dialogue around education in recent years has been focused on new specifications, their requirements and the need to deal with the increased emphasis on knowledge content. Is it possible that, in the midst of all this, we've lost sight of something more important: the moral responsibility that we have to convey knowledge to our students?

When we read Gert Biesta's 2009 paper 'Good education in an age of measurement', it feels prophetic. He argues that the rise of 'factual' data around education has narrowed our vision, and that instead of asking fundamental questions about value and purpose in education, we are focused on effectiveness. He claims that the role of effectiveness is then overemphasised, and that we quickly value what we can measure, rather than what we should. Consider a conversation that you had with a group of students recently regarding the purpose of education. Who, in that conversation, was the first to talk about entry into a sixth form or college, or university, or employment? I know that it's often me who takes the conversation there! Biesta challenges us to move away from that mindset and instead to refocus on questions of purpose.

So what should our purpose be? Michael Young, in a recent issue of *Impact* (2018) and for many years prior to it, has challenged us to consider the role of teachers as those responsible for conveying powerful knowledge to the students in our care. The distinguishing features of powerful knowledge, its specialised and distinctive nature, place a burden of responsibility on our curriculum leaders to be able to articulate not only what they teach, but also why the body of knowledge in their discipline is the best possible. Furthermore, Young helps us to recognise that despite the concerning trend to narrow the curriculum for some subgroups of students, we have a moral responsibility to convey this substantial, discipline-specific knowledge to all students: 'Denying access to this knowledge to some pupils, because they find it difficult, is like denying the equivalent of our Hippocratic oath – to make available to them the "best knowledge" that we can.' (Young , 2013, p. 115)

In light of this research and our own context, we have resolved to pursue a 'knowledge-rich' curriculum model, where substantive and disciplinary knowledge are the start point for all our students and where explicit instruction will help them to demonstrate this knowledge expertly. We've also committed to an increasingly intentional approach to how students learn in our curriculum development.

Picking our best bets

I would suggest that pursuing an evidence-based pedagogical approach is an ethical, rational and practical necessity (Jones, 2018b). It is an ethical choice in that it recognises our responsibilities to the young people in our care, a rational choice in that it makes sense to pursue the most effective means of achieving our aim of aiding students to make outstanding progress, and is a practical choice in that it will help hardworking staff to work smarter. In order to do this, we must strive to build meaningful professional relationships with a wide range of partners, including within higher education and across our own sector.

And as we have started to build these relationships with organisations to help us refine and improve our practice, the draft Ofsted framework has led us to ask questions not just about what we teach or how we teach it, but also why we teach it at all. These two elements – engagement with evidence and refining our curriculum – have become symbiotic in an exciting and daunting way.

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REFERENCES

Biesta G (2009) Good education in an age of measurement: On the need to reconnect with the question of purpose in education. *Educational Assessment Evaluation and Accountability* 21(1): 33–46.

Counsell C (2018) Taking curriculum seriously. *Impact* 4: 6–9.

Jones G (2018a) Evidence based practice: What it is and what it isn't. In: CEMblog. Available at: http://www.cem.org/blog/evidence-based-practice-what-it-is-and-what-it-isnt/ (accessed 5 April 2019).

Jones G (2018b) *Evidence Based School Leadership and Management: A Practical Guide*. London: Sage.

Sinek S (2009) *Start with Why: How Great Leaders Inspire Everyone to Take Action*. London: Penguin Books.

Young M (2013) Overcoming the crisis in curriculum theory: A knowledge-based approach. *Journal of Curriculum Studies* 45(2): 101–118.

Young M (2018) A knowledge-led curriculum: Pitfalls and possibilities. *Impact* 4: 1–4.

Cognitive load theory explored through modelling in the practical classroom

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The basis of teaching in a practical classroom, such as art and design or design technology, is the much repeated and reliable teacher-led demonstration. These demonstrations or modelling approaches allow the teacher to inform, instruct and guide students in their own practical outcomes; however, only recently have I considered the impact of cognitive load theory (CLT) upon how I deliver a modelling session to students.

Much has been mentioned recently on Twitter, in articles like this and in discussion at many school INSET and CPD sessions about CLT and the implications that it can have on us as teachers and our planning of the curriculum; we are encouraged to improve our instructional procedures in the classroom, ensuring that our teaching is tailored to students' knowledge and skills. Use of worked examples is key, as is the removal of inessential information and simplifying complex information by presenting it both orally and visually. However, the research is often heavily weighted towards those subjects that deliver lessons where theory teaching is prevalent, not classrooms where creativity and practical outcomes are a key component and a necessity for successful progression.

Gathercole and Alloway (2007) have stated that the working memory has a limited capacity, and handling too much information or engaging in a demanding task can overwhelm the working memory of students; this builds upon the initial research from Sweller et al. (1998), which asserts that the working memory of our mind can only handle a limited amount of information at one time. With this understanding in mind, my approach to demonstrations over the last year of teaching has adapted in an attempt to support student progress through the application of CLT.

The approach to modelling I initially took was to evaluate my current success rate of student understanding whilst I model a new technique; immediately, before checking student outcomes, it was clear that I used a lot of instructions, some not completely pertinent to the demonstration that I was completing. These wordy demonstrations completely discounted the processing capacity of my students, and this was evident in their outcomes. Within an introduction to the sewing machine lesson, students who succeeded had managed to follow my instructions or asked for support from their peers, whilst those students who needed further support asked considerably more questions or were on the verge of refusing to complete the task.

It then became necessary that I detailed for myself exactly what I wanted to discuss in my modelling, and explained that to students before completing the teacher-led demonstration. For example, in a GCSE art lesson, I was explicit that students must watch my control of the paintbrush when using acrylic paint and not concern themselves with the colour-mixing process. With Year 7 textiles, I decided to make the explicit skill a question that they could answer: how do you complete a successful straight line of sewing on the sewing machine? My modelling to students took a more focused approach and did have a positive impact upon the outcomes; however, it did then mean that, as a result, I was doing more teacher-led modelling sessions to cover all the skill and knowledge that I wished to in one lesson. This was not an approach I wished to maintain in the long term, as it made the modelling and learning process fragmented and unmanageable in the space of an hour's lesson. Therefore, I decided to spend time improving the teacher instruction, which hopefully will lead to the students doing more and doing it better.

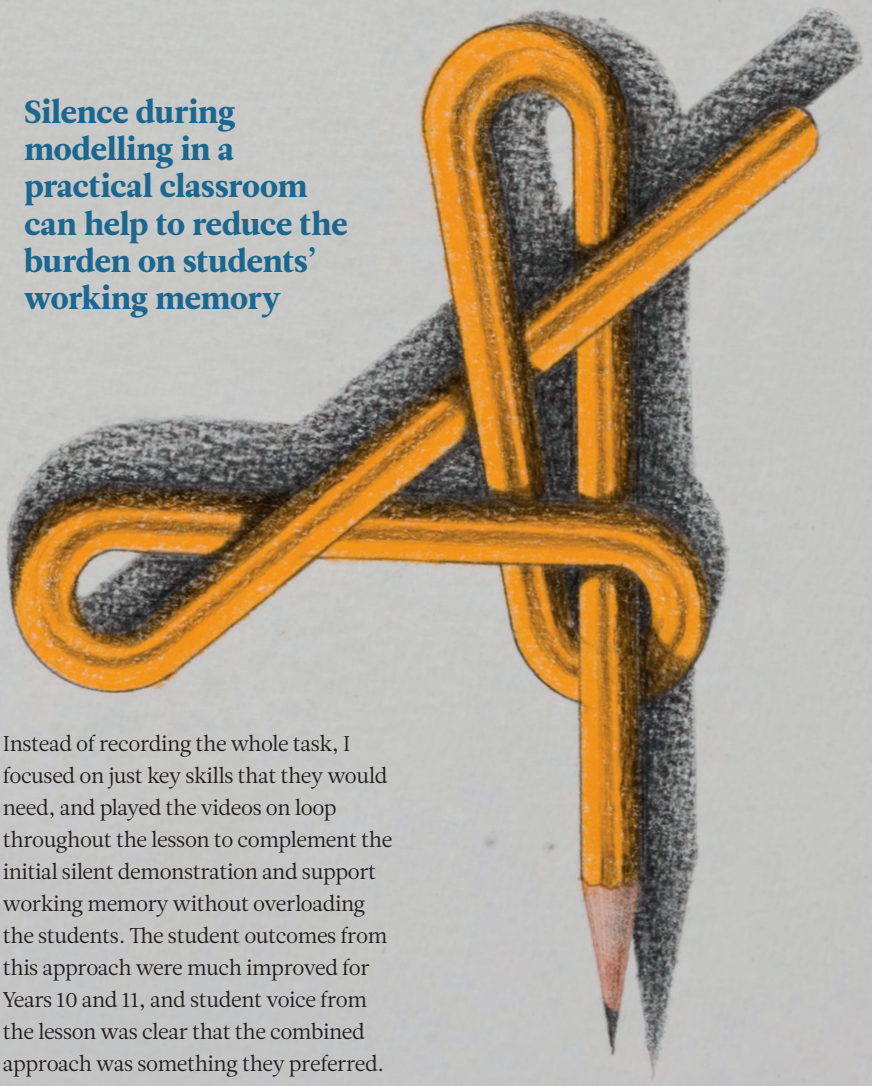
After a discussion with a colleague in maths, I was directed to an article by Linsin, 'Why silent modelling is a powerful strategy' (2014). Within this article, Linsin

asserts that when you model in silence, you are assured of providing the purest form of instruction. With this in mind, I again adapted my approach to modelling in lessons. This was by no means an easy task; I feel at a loss in demonstrations when I am not talking, and I was once reminded by a Year 7 that I shouldn't be talking.

When modelling in silence, it was clear that both my and student focus were much more intense; a member of staff who observed me silent-model commented on how attentive the students were whilst I was on the sewing machine. It by no means has been an easy approach to modelling; my GCSE classes are much more reticent about watching a silent demonstration and their attention wanes far quicker than my Year 7 classes. With the younger years, it is evident that they are more adaptable to new modelling techniques in the classroom, but they also enjoy watching a process come to fruition, whereas the older years are used to being told what to do and how to do it, and have been slower to follow the process and show success in comparison to Year 7 and 8 students. Having explored silent modelling in several practical demonstrations, my overriding concern was that if students missed a step, or if I didn't make a step clear to understand for novice learners who had never seen a teacher demonstration previously and did not know what to look for, how would they feel in the lesson regarding their working memory and lesson outcomes? How would they keep up with the practical process without the feeling of being overwhelmed by information?

It became necessary to find a way that I could still use silent modelling successfully; students would still watch a silent demonstration, but I would support it further with visuals. I had previously trialled showing them online videos of artists working and they had responded well to these and to the related discussions, so I utilised technology to record videos of myself completing the tasks that they would soon be required to do themselves.

Silence during modelling in a practical classroom can help to reduce the burden on students' working memory



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Instead of recording the whole task, I focused on just key skills that they would need, and played the videos on loop throughout the lesson to complement the initial silent demonstration and support working memory without overloading the students. The student outcomes from this approach were much improved for Years 10 and 11, and student voice from the lesson was clear that the combined approach was something they preferred.

Reflecting on my experience, I like how silence during a demonstration focuses attention – attention being another limited resource, like working memory (Weinstein et al., 2018). As the younger students progress through their creative education, they will have become used to silent modelling and there will be none of the reticence I received from Year 10 and 11 students this year.

Taking this idea forward, it is clear that silent modelling must be more carefully planned in terms of the teacher-led direction and the key skills that you wish students to practically use and develop. When supported with other forms of instruction and planning, silence during modelling in a practical classroom can help to reduce the burden on students' working memory and hopefully, in turn, lead to greater, more successful outcomes.

REFERENCES

Gathercole SE and Alloway TP (2007) Understanding working memory: A classroom guide. Available at: www.mrc-cbu.cam.ac.uk/wp-content/uploads/2013/01/WM-classroom-guide.pdf (accessed 5 August 2019).

Linsin M (2014) Why silent modeling is a powerful strategy. In: Smart Classroom Management. Available at: www.smartclassroommanagement.com/2014/09/27/why-silent-modeling-is-a-powerful-strategy (accessed 5 August 2019).

Sweller J, van Merrienboer JJG and Paas FGWC (1998) Cognitive architecture and instructional design. *Educational Psychology Review* 10(3): 251–296.

Weinstein Y, Sumeracki M and Caviglioli O (2018) *Understanding How We Learn: A Visual Guide*. Abingdon: Routledge.

Organising knowledge: The purpose and pedagogy of knowledge organisers

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A knowledge organiser (KO) sets out the important, useful and powerful knowledge on a topic on a single page (Kirby, 2015). With the content demands of new courses, and schools adopting a knowledge-based curriculum, these are becoming increasingly popular in schools at secondary and even primary level. With this in mind, what are the key principles to ensuring that these are designed and implemented effectively?

For these to become a useful classroom and study tool, we should consider the **purpose** (what is the point of a knowledge organiser?), the **content** (what should be included and how should it be presented?) and the **pedagogy** (how can knowledge organisers become a practical tool used effectively by teachers and students?).

Purpose

For students to succeed in a particular area, they must have a foundation of factual knowledge, understand those facts in the context of a conceptual framework and organise knowledge in order to facilitate retrieval and application (Bransford et al., 2000). We can see knowledge organisers as a way to enable this, in a much more systematic way than traditional revision guides and textbooks.

There are many arguments made for the necessity of the memorisation of important knowledge. Our working memory capacity is limited, so by storing more in our long-term memory, we can free up working memory capacity (Paas et al., 2003). With careful design and use of knowledge organisers, we can construct schemas, complex architectures of knowledge stored in long-term memory, with a view to automating their use (Paas et al., 2004). For a relatively complex task such as writing an English literature essay, for example, we can reduce the extraneous cognitive load by allowing students to access knowledge and quotations from their long-term memory.

It should be noted that knowledge organisers have a purpose outside the more obvious benefits for students. The construction and regular use of knowledge organisers can also develop teachers' subject knowledge. The process of creating knowledge organisers in a specific subject then leads to a consideration of pedagogical content knowledge, the integration of subject expertise and an understanding of how that subject should be taught (Ball et al., 2008). A knowledge organiser can be a valuable starting point for effective curriculum design and a useful primer for those new to the topic.

Content

When making decisions about what must be included we have to consider that not everything *can* be included on an A4 piece of paper. So we must balance the need to use concise space-saving definitions while still including meaning enough for it to be useful. The finite space also leads to choices about which knowledge we deem most important and which we exclude. Powerful knowledge, as defined by Young (2013), is *specialised* rather than general knowledge, and is *differentiated* from the experiences of students. Finally, we have to decide which knowledge is most useful for the understanding of the domain and which is important for the *sample* of the domain – the assessment. For example, the continued development of the USSR post-1945 would be useful knowledge for students studying *Animal Farm* but would not be assessed, so should it be included on the KO?

As well as what to include, we also need to think about how the material ›

With careful design and use of knowledge organisers, we can construct schemas, complex architectures of knowledge stored in long-term memory

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is presented. In knowledge organisers, information is commonly presented in list form, which not be the best way to depict it in terms of showing links between ideas. It is therefore important that information is organised in such a way as to facilitate *further* organisation. Material should also be presented in such a way that it can be easily tested, to maximise the opportunity for retrieval practice.

Pedagogy

The use of knowledge organisers needs to be integrated into teachers' practice and students' habits. This includes using the following strategies regularly and routinely.

Regular retrieval practice is important, because active retrieval aids later retention (Roediger et al., 2011). This can take various forms, e.g. low-stakes quizzes during lessons, or writing down the dates for key events in a timeline from the KO. It could be free recall, where students write down everything that they can remember on the topic, before checking the KO, or perhaps filling in a blank (or partially blank) knowledge organiser. Testing will also identify gaps in knowledge, lead to more learning on the next study session and produce better organisation of knowledge (Roediger et al., 2011).

We should ensure that the material included in knowledge organisers is elaborated upon, by relating it to additional knowledge associated with it, often in the form of 'why' questions. There is an element of retrieval practice contained in this strategy, known as elaborative interrogation, but it works by ensuring that there is some sort of active understanding and meaningful consideration of what is being learnt (Willingham, 2014). Building complex schemas requires knowledge to be connected, so that this can be used when learning X by asking, 'How does concept X relate to concept Y?'

Finally, we should ask students to organise the knowledge into something different in order to help recall and further understanding. Reif (2008) lists some forms of knowledge organisation: nearly random organisation; lists; network (associative network, concept map); hierarchy. The strategy of elaborative interrogation can be used to help build these particular organisational structures, but students should be asked regularly to organise the knowledge contained on the KO into different organisational structures. For example, a list of key historical figures from the Second World War could be organised hierarchically in terms of power/status, could be built into a concept map or could be re-ordered into another list.

All of these strategies should be regularly used by teachers, but we must ensure that students are aware of how and when to use these strategies themselves, something that won't happen without explicit instruction (Zimmerman, 2010). When using knowledge organisers in class, teachers can articulate why the particular strategy being used is effective and model its use with the KO. For students to get the most out of this, we can encourage them to use the metacognitive regulation cycle: plan how to undertake the task; monitor the effectiveness of the strategy; evaluate the overall success (Education Endowment Foundation, 2018). For example, students might wish to learn a series of events and dates, so they might plan to use flashcards in several ways. They know that retrieval practice is effective so they use them to self-quiz. They know that elaborative interrogation is important, so they consider why each event was important and how it contributed to ultimate outcomes. They understand that knowledge may stick better if organised in different ways, so they organise the dates chronologically. They monitor which dates are known, then retest those not yet learnt. They reflect, following this, on tricky dates and then place each in turn in the centre of a concept map and consider how each relates to the other dates.

Knowledge organisers are not a silver bullet, but they can form a central part of any knowledge-based curriculum when used in this systematic, evidence-informed way.

For examples of knowledge organisers, have a look at our CPD pack: **impact. chartered.college**

REFERENCES

Ball DL, Thames MH and Phelps G (2008) Content knowledge for teaching: What makes it special? *Journal of Teacher Education* 59(5): 389–407.

Bransford JD, Brown AL and Cocking RR (2000) *How People Learn.* Washington: National Academy Press.

Education Endowment Foundation (2018) Metacognition and self-regulated learning guidance report. Available at https://educationendowmentfoundation.org.uk/public/files/Publications/Campaigns/Metacognition/EEF_Metacognition_and_self-regulated_learning.pdf (accessed 1 July 2018).

Kirby J (2015) Knowledge organisers. In: Pragmatic education. Available at: https://pragmaticreform.wordpress.com/2015/03/28/knowledge-organisers/ (accessed 1 July 2018).

Paas F, Renkl A and Sweller J (2003) Cognitive load theory and instructional design: Recent developments. *Educational Psychologist* 38(1): 1–4.

Paas F, Renkl A and Sweller J (2004) Cognitive load theory: Instructional implications of the interaction between information structures and cognitive architecture. *Instructional Science* 32: 1–8.

Reif F (2008) *Applying Cognitive Science to Education: Thinking and Learning in Scientific and Other Complex Domains.* Massachusetts Institute of Technology: Bradford Books.

Roediger HL and Karpicke JD (2006) Test-enhanced learning: Taking memory tests improves long-term retention. *Psychological Science* 17: 249–255.

Roediger HL, Putnam AL and Smith MA (2011) Ten benefits of testing and their applications to educational practice. *Psychology of Learning and Motivation* 55: 1–36.

Willingham DT (2014) Strategies that make learning last. *Educational Leadership* 72(2): 10–15.

Young M (2013) Overcoming the crisis in curriculum theory: A knowledge-based approach. *Journal of Curriculum Studies* 45(2): 101–118.

Zimmerman BJ (2010) Becoming a self-regulated learner: An overview. *Theory Into Practice* 41(2): 64–70.