

the bulletin

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A Message from our CEO

Mandy Nayton OAM

I hope this message finds you safe and well. As with communities across the world, we have an incredibly challenging period ahead - and I trust that everyone reading this Bulletin has access to the support, encouragement and advice they need.

The purpose of this message is to let you know how the DSF team is responding to the COVID-19 pandemic – and to tell you a little about the services that we will be offering over the next few months. Our aim is to continue to support the schools, families and organisations that we currently work with (as well as those who are new to DSF) in a manner that is appropriate for these rapidly changing times.

We are currently working incredibly hard to shift most of our services to on-line platforms so that members of the wider community (including schools) can continue to access high quality clinical services, tutoring, professional development and resources via the internet. Much of this delivery will be personalised and interactive and we hope to begin the process of rolling out on-line services in the next two to three weeks. We look forward to your feedback on the experiences you have as you begin connecting with the DSF programs and resources available.

Professional Learning:

Much of our professional learning is being redesigned as synchronous on-line training, that will be both interactive and highly engaging. Our goal is to ensure that in the coming weeks and months a wide range of workshops will be made available to schools, individual teachers and allied health professionals – keen to engage in high quality, evidence-informed training. Initially, our aim will be to offer the schools and individuals who had booked workshops with us, an opportunity to transfer their existing registrations to an on-line version of the same training. We will then schedule new workshops and training sessions for all those keen to participate in one or more of DSF's highly sought-after training packages. We will keep all on our mailing list informed as workshops are scheduled but I suggest also keeping a close eye on our website.

Clinical Services:

Given the high demand for both DSF psychology and speech pathology

services, we have been investigating a range of options that will ensure that we can continue to offer these services to families and schools throughout Western Australia. We have, however, been extremely careful not to adopt an approach that reduces the quality and efficacy of any of the clinical services provided. Our aim is to offer consultations, therapy and assessments on-line using a video-conferencing approach – enabling the psychologist or speech pathologist to engage directly with the child, adolescent or adult attending the appointment. We will be contacting everyone who already has a booking and checking to see whether they are happy to transfer across to the new format.

A benefit of this approach is that families who live outside the Perth metropolitan area will be able to access DSF's clinical services far more easily.

Tutoring:

Over the past two weeks we have been providing training to all DSF specialist teachers to ensure that they are effectively prepared to deliver on-line tutoring. From the beginning of second term, all individual and small group (participants located separately) tutoring will be provided on-line and will, in all cases, be personalised and interactive. This will apply to both individual tutors and to the tutoring services that are offered in any of the DSF Literacy Clinics. We have been impressed with the response to the training and excited about the possibilities on-line tutoring offers.

This change also allows us to meet the needs of more families in regional and remote locations.

Support and Advocacy:

It is of enormous importance to us that we continue to support children and adults with language and learning difficulties, their families and, of course, the professionals who work with them. This edition of the Bulletin magazine has been shared electronically with all DSF members, all schools across Western Australia – and

to all those in the wider community who have a standing order for the Bulletin with us. In addition, we are sharing a range of our most popular resources with the Department of Education to make available on their website – and we will be posting regular teaching tips and free resources on our website and via social media. We will also be moving our free parent information sessions on-line from the beginning of May.

Library:

Unfortunately, as has been the case with other libraries, the DSF library is no longer open to the public. Our members can, however, borrow resources through an on-line reservation system and we will post the resources out to you with a reply-paid satchel included with the resources. Members will receive an invoice for the postage, including the cost of returning the items to DSF. This will allow borrowers to drop their returned books into a street post-box rather than visiting a Post Office. The postage fee will depend on the size and number of items being borrowed. DSF library staff will determine which of the three satchel sizes is needed for the requested items and invoice accordingly. Please contact DSF to find out more about this service.

Bookstore:

There will be very few changes to the way in which the DSF bookstore operates. We do, however, anticipate that many of the families and schools we work with will be in touch to discuss suitable resources for students learning at home. We will be providing suggestions in the coming weeks and months in relation to those resources that are likely to prove particularly useful for this purpose; and will also be creating bundles of resources and DSF strategies that are ideal as 'working at home' packages. Unfortunately, the option of picking up book orders from DSF will not be available in the coming months but, assuming resources are in stock, we will certainly be able to send them to you quickly and efficiently.

We will continue to provide updates on our services through the DSF website (dsf.net.au), the DSF Facebook page (www.facebook.com/dyslexiaspeld) and through emails. As indicated at the outset, I hope that you, your colleagues, your families and your communities remain safe and well throughout these challenging times.

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ULD e-Learning Course Available Online Now

The Understanding Learning Difficulties e-learning course was designed to equip teachers, school psychologists, speech pathologists, specialist tutors and parents with the knowledge required to support students with learning difficulties throughout their education. This online learning program consists of six interactive modules that systematically cover: an introduction to learning difficulties and learning disorders; the cognitive processing skills implicated in learning; and, the response to intervention (RTI) model. Participants will also learn about how

to reduce the incidence of literacy and numeracy difficulties, remediate learning difficulties and put in place appropriate support strategies and accommodations.

This e-learning course provides a carefully constructed blend of written information, videos, downloadable resources, interactive activities and animations - all of which combine to produce an enjoyable and engaging online learning experience. All aspects of the identification and support of students with learning difficulties and learning disorders will be covered.

Specifically, the six, 2-hour modules of this course will cover:

1

Module one introduces the participant to learning difficulties and disorders and includes a discussion of how learning disorders are identified, what they look like in the classroom and who should assess and diagnose.

2

Module two introduces the participant to the underlying processing skills necessary for academic success, including phonological processing, working memory, orthographic processing and number sense.

3

Module three introduces the response to intervention model. This module covers what the RTI model looks like in the classroom, how to modify tasks between tiers and the role of screening and assessment.

4

Module four focuses on high-quality initial teaching of literacy and numeracy. This module will examine what aspects of literacy and numeracy require explicit teaching in the initial stages and what resources can be used to support this teaching.

5

Module five looks at classroom strategies and how best to support the learning process of students with learning difficulties. The concept of universal design for learning is discussed along with current best practice accommodation guidelines.

6

Module six introduces the participant to strategies to support the emotional wellbeing and resiliency of students with learning disorders. This module also includes a series of case studies demonstrating effective support of students with SLD's.

For more information, go to <https://dsf.net.au/our-services/professional-learning/online-learning>

Of ‘Hard Words’ and Straw Men: Let’s Understand What Reading Science is Really About

By Dr. Louisa Moats

Emily Hanford of American Public Media has written several award-winning reports about dyslexia and reading instruction (“At a Loss for Words: What’s Wrong with How Schools Teach Reading?”). Each one has prompted nationwide discussion. I applaud the depth and insightfulness of these remarkable blogs and podcasts.

The time has come to call the public’s attention to reading science and to dispel the misconceived beliefs and practices that are so widespread in our classrooms. Not all readers and listeners, however, are persuaded by Hanford’s reporting. Various critics’ blogs and opinion papers have challenged her analyses. In doing so, unfortunately, these sceptics have resurrected some worn-out straw men that once again, require rebuttal. They include the idea that reading science is just about phonics and scripted programs; that it does not address all the important aspects of teaching; and that it does not address reading comprehension.

First, the body of work referred to as “the science of reading” is not an ideology, a philosophy, a political agenda, a one-size-fits-all approach, a program of instruction, or a specific component of instruction. It is the emerging consensus from many related disciplines, based on literally thousands of studies, supported by hundreds of millions of research dollars, conducted across the world in many languages. These studies have revealed a great deal about how we learn to read, what goes wrong when students don’t learn, and what kind of instruction is most likely to work the best for the most students. Mark Seidenberg’s (2017) book, *Language at the Speed of Sight*, summarises that science as well as any.

Second, with regard to the importance of teaching phonics systematically, explicitly, and cumulatively, the scientific consensus (see Foorman et al., 2016) is very strong. Most of the studies that show positive effects in comparison to “business as usual” have provided phonics instruction about 30–45 minutes per day, using different instructional materials. Good

phonics instruction, moreover, is hands-on and moves from presentation of a concept to practice exercises and then to its direct application in reading and spelling. If phonics instruction is boring, rote, or meaningless, as critics tend to claim, the fault is with the practitioner and/or program designer. As we provide LETRS® (Language Essentials for Teachers of Reading and Spelling®) professional development, we find that many teachers simply don’t know how to make phonics lessons fun and engaging. That is mainly because they have not been taught how spoken and written words work, and they are uncomfortable teaching students how to decode and spell. We can change that with good courses, better materials, and professional development like LETRS®.

Third, the body of scientific evidence about reading is not limited to the importance of phonics instruction. Perhaps the most critical and least-practiced component of effective early instruction is phoneme awareness. Awareness of the sounds that make up spoken words, facility at manipulating those sounds, and the links between speech and print must be mastered for students to be fluent readers and accurate spellers of an alphabetic writing system like ours. Phonics and spelling instruction may not make sense to students unless they are developing a fairly high level of proficiency with phoneme awareness (see Kilpatrick, 2015). Yet we still have many classrooms where little to no deliberate development of phonological skills takes place, and many kids fall behind as a result. The best antidote for this problem is instruction for teachers in the speech sound system and its correspondence with print, supported by good instructional materials.



Fourth, reading science has not neglected the importance of language comprehension and the challenges of reading comprehension. While this aspect of reading is more difficult to research than foundational reading skills, we can hang our hat on certain robust findings. They include the critical importance of building vocabulary and background knowledge for text reading, and the value of a content-rich curriculum that is more focused on what the students are learning about than it is on teaching specific comprehension skills (e.g., see Wexler, 2019). Comprehension skills, such as how to find the main idea or how to write a summary, generalise better if they are practiced in the context of learning about a worthwhile topic.

As the Hard Words reports have documented, much classroom instruction is driven by ideas advanced by “balanced literacy” programs. “Balance” is an appealing term but in reality, it has meant little to no systematic instruction in foundational reading skills, including phoneme awareness, phonics, and fluent word recognition. Children are taught to rely on context and pictures to identify printed words, a practice that reinforces what poor readers naturally do. In all respects, from word reading skills to language comprehension development, these approaches are not consistent with best evidence.

A well-designed early-reading program would teach these foundational skills explicitly and systematically, with adequate time devoted to each:

- Awareness of speech sounds, segmentation, manipulation of sounds
- Letter formation and writing by hand
- Phoneme-grapheme correspondences
- Spelling patterns
- Meaningful word parts (morphemes)

Then, each skill or concept would be applied to phrase, sentence, and passage reading—we hope in the context of learning about something of importance. Then, language comprehension can be nurtured through rich content learning, reading aloud, classroom discussion, and deliberate study of language at the level of sentences, paragraphs, and longer texts. Good instruction is never “regurgitation without comprehension.”

We are, of course, facing many difficult challenges in education. But how to teach reading so most students learn early and well -THAT should be on the list of things we can do something about. We just have to bury a few more of those straw men.

This blog first appeared on <https://www.voyagersopris.com/blog/edview360/2019/10/16/lets-understand-what-reading-science-is-really-about> dated 16 December 2019. Used with permission.

* DSF provides LETRS® training around Australia

Louisa Moats has been a teacher, psychologist, researcher, and author of many influential scientific journal articles, books and policy papers on the topics of reading, spelling, language and teacher preparation. Dr Moats developed her current approach to teacher training, called LETRS, from her experiences as an instructor at Harvard Graduate School.

On Formative Assessment in Maths: How Diagnostic Questions Can Help

By Craig Barton

I am going to start with a rather big claim: asking and responding to diagnostic questions is the single most important thing I do every lesson. This article will be my attempt to convince you why.

For 13 years, I have taught maths to students ages 11 to 18 in the United Kingdom. For much of my career, I did not reflect on why I was doing the things I did. I was a relatively successful teacher, whose students always got decent results and seemed to enjoy their lessons, and that was good enough for me. It was only when I started my Mr Barton Maths Podcast (www.mrbartonmaths.com/podcast) that my cosy little world began to crumble. Interviewing educators from around the world really made me stop and question practices that I had done for many years without really thinking about them. These conversations led to two years of reading hundreds of books and research articles; trying, failing, and tweaking new ideas with my students; and eventually writing a book: *How I Wish I'd Taught Maths: Lessons Learned from Research, Conversations with Experts, and 12 Years of Mistakes*.

One of those key mistakes I made was to ignore the immense power of formative assessment.

Formative assessment is a phrase that is bandied around a lot. It is something all teachers are told we have to do, but often without any real substance or conviction. It is marketed as a generic teaching strategy—one that can be used across all subjects—and so it is usually accompanied by whole-school training sessions, where us mathematics teachers are presented with examples from English, history, and geography and persuaded that they will definitely work for the likes of equations, percentages, and histograms.

So for much of my career, I steered clear of any mention of formative assessment. Then I came across the work of Dylan Wiliam, an

expert on the topic. And it is a good thing I did, because I am now convinced that teaching without formative assessment is like painting with your eyes closed.

In 2016, Wiliam sent the following tweet: "Example of really big mistake: calling formative assessment 'formative assessment' rather than something like 'responsive teaching.'"

Indeed, "responsive teaching" feels like a much better description to attach to the tools and strategies I will discuss here. The word "assessment" conjures up visions of tests and grades. For teachers, it means more work, and for students, more pressure. While it's important to see tests as tools of learning, the association with assessment has probably not helped the development and adoption of this most valuable of strategies.

Paul Black, a prominent researcher on formative assessment, and Wiliam explain that an assessment functions formatively "to the extent that evidence about student achievement is elicited, interpreted, and used by teachers, learners, or their peers, to make decisions about the next steps in instruction that are likely to be better, or better founded, than the decisions they would have taken in the absence of the evidence that was elicited."

Others define formative assessment as "the process used by teachers and students to recognise and respond to student learning in order to enhance that learning, during the learning."

Wiliam makes the point that any assessment can be formative, and that assessment functions formatively when it improves the instructional decisions that are made by teachers, learners, or their peers.

For me, formative assessment is all about responding in the moment. It is about gathering as much accurate information about students' understanding as possible in the most efficient way possible, and making decisions based on that. In short, it is about adapting our teaching to meet the needs of our students.

Classroom Culture

If students are afraid of making mistakes, how can we learn from their misunderstandings?

We have probably all taught students who leave questions out in tests and homework for fear of being wrong, and we all know that such actions make it incredibly difficult to help them, as we have no indication of how much or in what areas their understanding is lacking. However, in my experience, far more common is a fear of making mistakes away from the written page. Many formative assessment strategies—and indeed the one I am going to focus on here—require students to be public about their answers, displaying their thoughts in front of their teacher and peers in the moment. If students fear making mistakes, and the consequences of those mistakes, then it is highly likely that they will fail to provide us with any useful information at all. After all, for the child who fears failure, not giving a response is far less daunting than having a go.

So how do we create a classroom culture that helps students overcome this problem?

By ensuring that the questions we ask students are seen not as tools of assessment but as tools of learning. We can only hope to achieve this if there are no negative consequences for being wrong. We can do this by not grading

or recording students' responses to the formative assessment questions we ask in class, for the presence of a grade or record puts a premium upon success, and they are not needed to inform our decisions in the moment.

There also must be positive consequences for honest participation; mistakes need to be embraced as learning opportunities. I know that sounds ridiculously clichéd, but it is true.

Students opting out

Another factor that can render any assessment strategy—but in particular classroom-based formative assessment—limp and ineffective is the classic opt-out. Some students may choose not to give an answer not for fear of being wrong but, to put it bluntly, because they don't want to think. A shrug, an utterance of "I don't know," or a wall of silence tells us absolutely nothing about a student's understanding of a given concept, and thus leaves us powerless to help.

Allowing such a response also conveys the message that nonparticipation is absolutely fine.

Wiliam argues that engaging in classroom discussion really does make students smarter. So, when teachers allow students to choose whether to participate or not—for example, by allowing them to raise their hands to show they have an answer,

or settling for a lack of response—we are actually making the achievement gap worse, because those who are participating are getting smarter, while those avoiding engagement are forgoing the opportunities to increase their ability.

Finding comfort in one correct answer

Directly related to students themselves opting out is a common practice among teachers (myself very much included) that essentially does the student's job of opting out for them. See if this scenario rings any bells:

Me: So, does anyone know what $-5 - -2$ is? (Three hands go up, one of which is Josie. Josie always gets everything right.)

Me: Josie, go for it.

Josie: -3 , sir.

Me: And why is that, Josie?

Josie: Because subtracting a minus is the same as adding a positive, and negative 5 plus 2 gives you negative 3.

Me: Loving your work as ever, Josie. OK, let's move on.

Well, that is exactly how many of my early attempts to assess the understanding of my students proceeded. In one book on formative assessment, a teacher is quoted as describing such a scenario as





“a small discussion group surrounded by many sleepy onlookers.” Likewise, when I interviewed William for my podcast and asked him to describe an approach in the classroom that he doesn’t think is effective, he replied: “Teachers making decisions about the learning needs of 30 students based on the responses of confident volunteers.” Rarely have truer words been spoken. I find solace in the fact that I am not alone. William himself describes a similar experience:

When I was teaching full-time, the question that I put to myself most often was: “Do I need to go over this point one more time or can I move on to the next thing?” I made the decision the same way that most teachers do. I came up with a question there and then, and asked the class. Typically, about six students raised their hands, and I would select one of them to respond. If they gave a correct response, I would say “good” and move on.

One of professor Robert Coe’s “poor proxies for learning” is “(at least some) students have supplied correct answers,” and it is easy to see why. I am seeking comfort in one correct answer. When Josie once again produces a perfect answer and a lovely explanation, I make two implicit assumptions: first, that this is down to my wonderful teaching; and second, that every other child in the class has understood the concept to a similar level. But, of course, I have no way of knowing that. By essentially opting out the rest of the class, the only information I am left with concerns Josie.

There are ways around this. We can use popsicle sticks or other random name generators to ensure each student has an equal chance of being selected. These adaptations certainly improve my initial process, but they suffer from the same fatal flaw. All students are not required to participate to the same degree, and so the only student’s understanding I have anything resembling reliable evidence about is the student answering the question. Researcher Barak Rosenshine’s third principle of instruction is: “Ask a large number of questions and check the responses of all students.” In the past, I often failed to do that. However, the strategy involving diagnostic questions that I am going to outline below has the full participation of each and every student, along with an explicit use of mistakes, built in to its very core.

What Is a Diagnostic Question?

I used to believe two things that fundamentally dictated how I asked students questions and offered them support:

1. For any given question, there were two groups of students: those who could do it and those who could not. Those who could do it were fine to get on with the next challenge, and those who could not needed help. Crucially, they needed the same help.
2. Closed questions are bad, and open questions are good. Closed questions

encourage a short response, whereas open-ended questions demand much greater depth of thought. Hence, I spent many years fighting the urge to ask students closed questions in class, and instead opted almost exclusively for things like, “Why do we need to ensure the denominators are the same when adding two fractions?” or “How would you convince someone that $\frac{3}{7}$ is bigger than $\frac{4}{11}$?”

I will return to the first belief in due course, but first let’s deal with the nature of questions.

These two fraction questions are certainly important questions to ask students. But if our aim is to quickly and accurately assess whole-class understanding so we are able to make an informed decision on how to proceed with the lesson, they are not so good.

Their strength is their weakness. The fact that they encourage students to think, take time to articulate, and provoke discussion and disagreement makes them entirely unsuitable for effective formative assessment. How would we go about collecting and assessing the responses to “Why do we need to ensure the denominators are the same when adding two fractions?” from 30 students in the middle of a lesson as a means of deciding whether the class is ready to move on?

Open-ended questions like these are great for homework, tests, extension activities, and lots of other different situations.

However, they are not great for a model of responsive teaching.

Nor is it the case that closed questions prevent thinking. William gives the example of asking if a triangle can have two right angles. This is about as closed a question as you can get—the answer is either yes or no. But the thinking involved to get to one of those answers is potentially very deep indeed. Students may consider whether it is possible to have an angle measuring 0 degrees, or if parallel lines will meet at infinity. But this closed question, while it is indeed a brilliant one, is equally unsuited for a model of responsive teaching. If a particular student answered no, would we be convinced that he understood the properties of triangles and angles fully? Or has he just guessed? Without further probing, it is impossible to tell, and hence we are back to the same issues we have with the more open-ended fraction questions above.

So, if open-ended questions are unsuitable for this style of formative assessment, and not all closed questions are suitable, then what questions are left?

Step-forward diagnostic multiple-choice questions, or just diagnostic questions, as I refer to them.

Diagnostic questions are designed to help identify and, crucially, understand students’ mistakes and misconceptions in an efficient and accurate manner. Mistakes tend to be one-off events—the student understands the concept or the algorithm, but may make a computational error due to carelessness or cognitive overload. Give students the same question again, and they are unlikely to make the same mistake; inform the students that they have made a mistake somewhere in their work, and they are likely to be able to find it. Misconceptions, on the other hand, are the result of erroneous beliefs or incomplete knowledge. The same misconception is likely to occur time and time again. Informing the students who have made an error due to a misconception is likely to be a waste of time, as, by definition, they do not even know they are wrong. Good diagnostic questions can help you identify and understand both mistakes and misconceptions.

The best way to explain a diagnostic question is to show you one:

What is the size of the angle marked p ?

A 125° **B** 65° **C** 115° **D** 85°

Take a moment to look at the question and, in particular, the four different answers. What would each of these answers tell you about the understanding of a student who gave them?

Answer A may suggest that the student understands that angles on a straight line must add up to 180 degrees, and that the student is able to identify the relevant angle, but that he has made a common arithmetic error when subtracting 65 from 180.

Answer B may be the result of students muddling up their angle facts, mistakenly thinking this is an example of vertically opposite angles being equal.

Answer C is the correct answer.

Answer D may imply that the student is aware of the concept that angles on a straight line must add up to 180 degrees, but that the student has included all visible angles in her calculations.

Notice how each of these answers reveals a specific and different mistake or misconception. Imagine you had a group of students who answered A, another group who answered B, and a final group who answered D. Would all three groups require the same intervention from you, their teacher?

I don’t think so. Which brings us to my second (erroneous) belief. It is not always the case that students either can or cannot answer a question correctly. Sure, there may be some students who get the question correct for the same or similar reasons. But there are likely to be students who get a question wrong for very different reasons, and it is the reason they get the question wrong that determines the specific type of intervention and support they require.

For example, students who answered B and D may benefit from an interactive demonstration (for example, using GeoGebra (a free maths app) to illustrate the relationship between angles on a straight line. Students who chose B could then be presented with an exercise where they are challenged to match up an assortment of diagrams with the angle fact they represent. Those who selected D may benefit more from a selection of examples and nonexamples of angles on a straight line. But what about students who answered A? Their problem lies not with the relationship between the angles, but with their mental or written arithmetic. This may be a careless mistake, or it may be an indication of a more serious misconception with their technique for subtraction. Either way, it is not a problem that is likely to be solved by giving these students the same kind of intervention as everyone else.

Diagnostic questions are designed to help identify and, crucially, understand students’ mistakes and misconceptions in an efficient and accurate manner.

Diagnostic questions - I know of no more accurate, efficient way of getting a sense of my students' understanding of a concept, and then adjusting my teaching to meet their needs.

However you choose to deal with these students, there is little doubt that there is an advantage to knowing not just which students are wrong, but why they are wrong. And I have never come across a more efficient and accurate way of ascertaining this than by asking a diagnostic question.

So, what makes a question a diagnostic question? For the way I define and use them, there needs to be one correct answer and three incorrect answers, and each incorrect answer must reveal a specific mistake or misconception. I can—and indeed do—ask students for the reasons for their answers, but I should not need to. If the question is designed well enough, then I should gain reliable evidence about my students' understanding without having to have further discussion.

What Makes a Good Diagnostic Question?

Not all diagnostic questions are born equal, and writing a good one is hard. Indeed, the more I use diagnostic questions with my students and colleagues, the more I read about misconceptions in mathematics, and the more experience I get in writing them, the harder I am finding it! I take some solace from the fact that this could very well be the Dunning-Kruger effect playing out, in that as I grow more knowledgeable, I am also more aware of the difficulty of the challenge as well as my own considerable deficiencies.

At the time of writing, I have written around 3,000 diagnostic multiple-choice questions for mathematics. The vast majority of these I have used with my students either in the classroom or as part of an online quiz on my Diagnostic Questions platform, and many have been tweaked, adjusted, and binned over the years. Throughout that time, and inspired by the work of Caroline Wylie and William, I have devised a series of golden rules for what makes a good diagnostic question:

Golden Rule 1: It should be clear and unambiguous.

We all have seen badly worded questions in exams and textbooks, but with diagnostic questions, sometimes the ambiguity can be in the answers themselves. Consider the following question:

What is $\frac{1}{12} + \frac{7}{12}$?

- A B C D
 $\frac{8}{24}$ $\frac{8}{12}$ $\frac{7}{12}$ $\frac{2}{3}$

At first glance, nothing may appear all that wrong. The wording of the question is clear, and the incorrect answers reveal specific misconceptions. But what is the correct answer? D is clearly correct, and is probably the author's intended correct answer. But how about B? Given that the question does not ask students to simplify their answers, B is a perfectly legitimate correct answer. So, what do we infer if students answer B? Is it that they cannot simplify fractions, or that they did not see D? Do they believe B is the only correct answer, or just one correct answer? The key point is that without asking them, we do not know for sure. And a key feature of a good diagnostic question is that we should be able to accurately infer a student's understanding from her answer alone without needing further student explanation. In its current form, this question may be a good discussion question, but it is not a good diagnostic question.

Golden Rule 2: It should test a single skill/concept.

Many good questions test multiple skills and concepts. Indeed, a really effective way to interleave, which is where topics are studied in short bursts with frequent switching (as opposed to presented in blocks), is to combine multiple skills and concepts together within a single question. But good diagnostic questions should not do this. The purpose of a diagnostic question is to home in on the precise area that a student is struggling with and provide information about the precise nature of that struggle. If there are too many skills or concepts involved, then the accuracy of the diagnosis invariably suffers.

Golden Rule 3: Students should be able to answer it in less than 10 seconds.

This is directly related to Golden Rule 2. If students are spending more than 10 seconds thinking about the answer to a question, the chances are that more than one skill or concept is involved, which makes it hard to determine the precise nature of any misconception they may hold.

Golden Rule 4: You should learn something from each incorrect response without the student needing to explain.

A key feature that distinguishes diagnostic multiple-choice questions from nondiagnostic multiple-choice questions is that the incorrect answers have been chosen very, very carefully in order to reveal specific misconceptions. In fact, they are often described as distractors, although I do not like this term, as it implies they are trick answers. The key point is that if a student chooses one of these answers, it should tell you something.

Golden Rule 5: It cannot be answered correctly while still holding a key misconception.

This is the big one. For me, it is the hardest skill to get right when writing and choosing questions, but also the most important. We need to be sure that the information and evidence we are receiving from our students is as accurate as possible, and in some instances that is simply not the case.

Consider the following question:

What of the following is a multiple of 6?

- A B C D
 20 62 24 26

On quick inspection, this question looks pretty good. C is the correct answer, B may indicate that students believe multiples start with the given number, and D may indicate that they believe they end with that number. I am not entirely sure what A tells me—maybe an error with the 6 times table—but apart from that, I am pretty happy with this question.

Or am I? If I am going to use this question in class, presumably my purpose is something along the lines of assessing if students have a good understanding of multiples. And yet, something that is not assessed at all in this question is arguably the biggest misconception students have with the topic.

Imagine you are a student coming into your maths lesson and you are told that today you are studying multiples. Oh no, you think, I always get multiples and factors muddled up—I can never remember which ones are the bigger numbers. And then you are presented with the question above, and a smile appears on your face. You can get this question correct without knowing the difference between factors and multiples, as there are no factors present. And if I am your teacher, and several of your peers have the same problem, it could well be the case that you all get this question correct and I conclude that you understand factors and multiples, without ever testing to see if you can distinguish between the two concepts.

Interestingly, by presenting my students with this question, they may subsequently infer that multiples are “the bigger numbers” due to the absence of any number smaller than 6, and hence may learn the difference between factors and multiples indirectly that way. However, this is something I would prefer to assess directly, especially if I am trying to discern in the moment if I have enough evidence to

move on.

So, a better question might be something like this:

Which of these is a factor of 27?

- A B C D
 7 13.5 54 3

I love this question—not just because it contains factors and multiples, but because of answer B. All of a sudden, dodgy definitions of factors, such as a number that goes into another number a whole number of times, are called into question.

Seeing as I make such extensive use of diagnostic questions, I want to ensure that the information I receive back from my students' answers is as accurate and valid as possible. Hence, putting such time into the creation and selection of good questions is time well spent.

So, that is why I am more than a little obsessed with formative assessment, and my favourite tools for delivering it are high-quality diagnostic multiple-choice questions.

But how do I collect my students' responses? In the past, I would have messed around with electronic voting devices. But all it takes is an empty battery, a dodgy Wi-Fi signal, or a mischievous child, and your lesson can quickly be skidding off the rails. Mini-whiteboards too, while great for students writing down their work, fall prey to faulty pens and an apparently unavoidable adolescent urge to draw something not exactly related to the content of the lesson. No, once again I defer to William, who, when I interviewed him for my Mr Barton Maths Podcast, advised that students should vote with their fingers, because, as he said, *students may forget to bring a pen to a lesson, but they rarely forget their fingers.*

So, at the start of each lesson, I project a diagnostic question on my board. I ask students to consider the answer in silence. I then count down from three and ask them to raise their hand high in the air, showing one finger for A, two for B, three for C, and four for D. Quickly, I am able to get a picture of their understanding. I then ask a student who has chosen A to explain his reasoning, then a student who has chosen B, and so on. At the end of this process, we have a revote, and then—because there is a danger that students are just copying the perceived cleverest student in the class—I ask a follow-up question that tests the same skill. Once my students are

used to this routine, it takes around two minutes per question, and I always ask at least three questions per lesson. And if some students are still struggling after the follow-up question, I am able to help them over the course of the lesson.

Which brings me to the final reason why I love diagnostic questions so much: the ability to plan for error. In the past, I would often find myself on the receiving end of a completely unexpected answer, while standing in front of a sea of 30 confused faces all looking to me for help. I would be forced to think on the spot—attempting to diagnose the error and think of a way of helping resolve it, all while trying to juggle the hundreds of other considerations tumbling through a teacher's mind in the middle of a lesson. Now, I do not need to. By using diagnostic questions and studying the wrong answers in advance, I can plan for these errors, ensuring I have explanations, resources, and strategies ready to help. My thinking can be done before the lesson, thus making me much more effective during the lesson.

I love good diagnostic questions. I know of no more accurate, efficient way of getting a sense of my students' understanding of a concept, and then adjusting my teaching to meet their needs.

Craig Barton has taught maths to secondary school students in the United Kingdom for 13 years. He is the creator of the websites www.mrbartonmaths.com, which offers free maths support and resources to teachers and students, and www.diagnosticquestions.com, which contains the world's largest collection of free diagnostic multiple-choice maths questions. He is also the host of Mr Barton Maths Podcast, which features interviews with inspiring figures in education.

This article is adapted with permission from his book, [How I Wish I'd Taught Maths: Lessons Learned from Research, Conversations with Experts, and 12 Years of Mistakes](#) (John Catt Educational, 2018). It first appeared in the Summer 2018 edition of [American Educator](#) and is used with permission.

References for this article can be found on our website at www.dsf.net.au/references

The Importance Of Evidence: Concerns About The Arrowsmith Program

CEO of the Dyslexia-SPELD Foundation (DSF), Mandy Nayton OAM, was recently asked to respond to a series of six questions regarding the Arrowsmith program. Here are her responses in full.

1. Broadly speaking, what are your concerns about the Arrowsmith Program?

The Arrowsmith program has been around for over 30 years but has been shrouded in secrecy throughout that time. No one really understands what the program involves, which means that it can't be independently assessed. The one peer-reviewed paper that has been produced lacks essential data, making interpretation of the results virtually impossible. Extraordinary claims are made about the success of the program, even though there is little, if any, evidence to support these claims. It is probably fair to say that when things sound too good to be true, they're probably not true.

If we were considering the introduction of a new approach in another field, such as medicine or engineering, the evidence supporting the approach would be considered carefully and openly. It is unlikely that someone claiming to have discovered a new treatment for cancer or a new approach to constructing bridges, would be taken seriously if they kept the details of the approach secret. They would not be able to sell their product for large amounts of money, or use the new technique, until such time as appropriate trials had been conducted and both the risks and impact assessed. We need to be very careful about what we are exposing children to and we need to be absolutely sure that there is not a more successful, targeted and cost-effective approach available.

It is also very surprising that there are no individual neuroscientists, or neuroscience laboratories anywhere in the world, that have made the extraordinary discoveries about the inner workings of the brain made by Arrowsmith over thirty years ago. This is despite the fact that there have been huge advances in the field of neuroscience and

that teams of educators, psychologists and neuroscientists from some of the world's most prestigious institutions have been investigating the impact of a wide range of interventions on the brain's architecture. The reality is that their findings are at odds with Arrowsmith's.

2. Are you concerned the program might prey on parents' desperation to address their child's perceived learning disabilities?

Absolutely! All parents want their children to be happy, healthy and successful. If a child is unhappy and struggling academically then, undoubtedly, a program claiming to completely turn this around will prove very appealing. If these claims are paired with apparent success stories, along with before and after pictures of the brain, then the message becomes even more attractive regardless of the significant costs involved.

Over the past two decades, our understanding of how children gain new knowledge and skills has grown enormously. We know far more about the most successful teaching approaches, including how best to help students who are falling behind. Of central importance is the use of targeted intervention. The brain-training techniques recommended by Arrowsmith are not supported by the current research and practice-based evidence widely available.

3. Barbara Arrowsmith Young, the founder of the Arrowsmith Program, has claimed that the latest research on the program has vindicated her approach to this issue. Do you find the research compelling?

No - unfortunately, the research report referred to is an in-house document designed to promote the Arrowsmith program. It is not an objective, independent review of the program. The one peer reviewed study that has been done has attracted some criticism for the lack of published data.

As Professor of Developmental Neuropsychology at the University of Oxford, Dorothy Bishop, has highlighted,



the Arrowsmith report initially describes the recruitment of three groups of children to participate in the study: 1) Children with learning disabilities (LD) attending the Arrowsmith program; 2) Children with LD receiving other intervention; and, 3) Typically developing children matched in age and sex. However, no data for the control groups are presented. "In their Discussion the authors show some awareness of the limitations of an uncontrolled pre-post design for drawing any conclusions about causality. This is important: the tests that they report may be subject to practice effects from repeated testing, or regression to the mean." (Bishop, 2019).

Given that the report only presents the results from the children participating in the Arrowsmith program, there is no way of knowing whether the Arrowsmith method - which is time consuming and expensive - is beneficial. Or, whether spending an equivalent amount of time and effort on an alternative, evidence-based, less expensive program would produce similar, or better, results.

There is also a conflict of interest to consider, as the lab conducting the Arrowsmith study receives funding from the Eaton Arrowsmith School. This conflict of interest was not disclosed in the research paper.

4. The anecdotal evidence from the parents of some children who have taken part in the Arrowsmith Program is also compelling to a lay person. Do people need to be wary when weighing the value of the anecdotal evidence?

The Arrowsmith program relies very heavily on anecdotal evidence. This is massively misleading as stories relating to the students who have failed or families that have been bitterly disappointed are never made available. One of the reasons for this is that families sign a confidentiality agreement at

the start of the intervention that prevents them from issuing any public comment or criticism of the program. Families can be taken to court for making a public statement about the program.

5. Neuroplasticity as a concept does appear to be increasingly accepted. As an expert, is there any validity to the science underpinning Arrowsmith's claims?

Neuroplasticity has been widely accepted for many years. The human brain is a remarkable organ and is viewed as having an open architecture with billions of connections between individual neurons across different parts of the brain. New neural pathways are constantly being formed and some connections are reduced through a process called pruning. Although the first few years of life are the brain's most active, the ongoing process of brain development is highly dynamic and flexible.

Any new learning - whether it is how to add two numbers, how to tie a bow, how to scramble eggs or how to use the remote control - results in changes to the brain. Brain images taken before and after someone learns how to play computer games successfully will show a change in the brain. This does not mean that the person will suddenly be better at anything other than playing computer games (and the things they were already good at).

While the Arrowsmith program claims to be based on neuroscience research by drawing on evidence for the localisation of brain functions (and dysfunctions), current neuroscience research does not support Arrowsmith's methods to remediate learning disabilities.

6. What would be your advice to parents who find the Arrowsmith Program's claims compelling and are considering enrolling their child in one of the schools in WA that offers it?

I would advise parents to seek opinions from experts in the field and to be wary of the claims that the program promoters make. Arrowsmith is a business and the aim of any business is to sell a product and make a profit. My suggestion would be to remain highly sceptical of any promotional material for any product that is designed to tug at the heart strings through the use of carefully selected anecdotes or that makes use of largely meaningless before and after brain images, as the cause and effect associated with these is often misinterpreted and misrepresented.

For information about choosing an effective literacy intervention program, go to <https://uldforparents.com/contents/selecting-a-successful-intervention-program/>

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The brain-training techniques recommended by Arrowsmith are not supported by the current research and practice-based evidence widely available.

What's New in 2020 - Events and Publications

Understanding Language Difficulties

A Practical Guide \$35.00

Approximately 10% of children in Australia have a language disorder (LD), of which approximately 7% present with a developmental language disorder (DLD). However, only a small number of these students are identified and supported during the school years.

Based on the hugely popular Understanding Learning Difficulties guide, DSF has developed a new practical guide for teachers and parents which includes up-to-date information on language difficulties. The guide includes:

- Identifying characteristics of LD from early childhood into adolescence;
- How LD is diagnosed;
- Best practice support strategies to help teachers to better support and accommodate children with language difficulties in the classroom; and
- How parents can monitor and help their child's language development

See page 22 for further information or go to <https://dsf.net.au/resources/online-store>



Becoming a Word Detective and a Writing Wizard



Reading and writing are juggling acts. Along with decoding (reading) and spelling skills, students need a strong vocabulary, a firm understanding of grammar, knowledge of different styles of writing, and good general knowledge. These bodies of knowledge provide the tools students need to make inferences, understand complex texts, and express their ideas clearly in writing - but they are the work of years to develop, and are particularly difficult to acquire for students who struggle to read and spell with accuracy.

DSF has developed *Becoming a Word Detective and a Writing Wizard* to support these students. This has been designed as a 9 to 10-week remedial program, for use with small groups of primary and high school-aged students. It draws on high-quality instructional approaches, including *Talk for Writing* and *Word Aware*, to develop students' vocabulary, grammar, comprehension and expression skills, through study of engaging texts. The program includes a teacher/tutor manual, student workbooks, resources for use within sessions, and samples of teaching materials.

DSF runs *Becoming a Word Detective and a Writing Wizard* sessions for students at the South Perth office, Park Centre Clinic and Mezz Clinic. The program resources will be available to purchase later this year.

See www.dsf.net.au for further information.

Upcoming Conferences

researchED Conference



17 October 2020 (rescheduled date), Bob Hawke College

researchED events focus on bridging the gap between research and practice in education. Researchers, teachers, and policy makers will come together for a day of information-sharing and myth-busting.

2021 Language, Literacy and Learning Conference



Save the date for this exciting event!

18-20 March 2021, Perth Convention & Exhibition Centre

The theme for DSF's third biennial conference is "Ensuring evidence informs practice". Six incredible international speakers will present keynote addresses over the three days of the conference. Expressions of interest are now open for practitioners and researchers who are keen to present in a breakout session. For more information, go to literacylanguageconf.com or email conference@dsf.net.au.

New to the DSF Bookshop

We have added a number of excellent resources to the DSF Bookshop in 2020, including two new series from Phonic Books, additional *Sounds-Write* resources, and a great range of up-to-date reference books. For further information on these items, please see pages 22-26.



Dyslexia: From School to the Workplace

By Sarah Tan
DSF Psychologist

It is estimated that 1 in 10 members of the population are dyslexic. This equates to approximately 1-3 children with dyslexia in every classroom in Australia. The difficulties these students may experience in the classroom varies from student to student but may affect their ability to read, spell, and write in addition to the way in which they remember, organise, understand and/or express information. When considering that a learning disorder, such as dyslexia, is a lifelong condition, it is important for students with dyslexia, as well as their parents and teachers, to contemplate the impact that a learning disorder may have on their working life beyond school.

Many students with dyslexia in Australia, from primary school through to tertiary education, are able to access supports and accommodations within the classroom, during their ATAR examinations, or in university lectures. Accommodations are designed to support learning, improve access to the curriculum, and allow students to demonstrate their knowledge, skills and understanding at the same level as their peers. However, this support often falls short when people enter the workforce. Research suggests that the lack of support for dyslexics in the workplace is related to several factors: a lack of understanding of the rights people with a learning disorder have in the workplace; a reluctance of individuals with dyslexia to inform prospective or current employers

of their learning disorder; and negative perceptions associated with learning disorders.

Nessa Corkery was always aware of her dyslexia, which was diagnosed during her first few years of school.

Eventually she studied nursing and wanted to work in a hospital environment. "I have always been a very confident person and hate to let people think that just because my brain processes things differently that I am not able to do what others can do."

She was offered support during college, including a recording pen for lectures, a laptop to dictate notes and extra time in exams.

However, this support fell short when she started her work placement. For the first time she felt really low.

"I was aware I was doing a bad job and no matter how much I tried I could not keep up with the other students," she says.

"It looked like I was complacent and just didn't care, but I just found it difficult to retain everything at the pace the others could. Nursing staffing shortages are a constant issue, so staff nurses are usually too stressed to take the time to teach students. I found it very difficult to ask for extra help as I was already considered a hindrance."

Excerpt from: We Need To Talk About Dyslexia At Work by Mauro Galluzzo

In 2011 to 2012, the Australian Bureau of Statistics participated in the Programme for the International Assessment of Adult Competencies (PIAAC) to assess literacy, numeracy, and problem solving in technology-rich environments (PSTRE) of adults aged 15 to 74 years. The underlying purpose of PIAAC was to gain understanding of these critical information processing skills given that individuals with lower skills in these areas are at risk of not being able to participate fully in the

labour market, education and training, and social and civic life. The study found that relatively large proportions of the adult population in Australia have poor literacy, numeracy and problem-solving skills, although this was consistent with other countries. Literacy was assessed in terms of a participant's ability to understand and respond appropriately to written texts, with proficiency described in terms of a scale of 500 points divided into six levels. 12.6% of adults in Australia attained only Level 1 or below in literacy. At Level 1 in literacy, adults could read brief texts on familiar topics and locate a single piece of specific information identical in form to information in the question or directive. While it was not clear how many of these people have a learning disorder such as dyslexia, Australian surveys have indicated around 10 to 16% of students are likely to have learning difficulties, particularly in literacy, while it is estimated that approximately 4% of Australian students have a specific learning disorder (such as dyslexia).

Dyslexia in the workplace

Within Australia, protection against discrimination based on disability throughout all stages of the employment process is provided through the Disability Discrimination Act 1992 (DDA). Dyslexia and other learning disorders are included within the definition of disability in the DDA. Just as schools are required to make adjustments in the classroom, employers are required to make adjustments to accommodate an employee's disability, unless that adjustment would result in unjustifiable hardship to the employer (such as severe financial hardship, technical limitations or heritage considerations).

Reasonable adjustments to the workplace include changes to premises, facilities, equipment, work practices or training that could help a person with disability safely perform the essential requirements of their job. These adjustments ensure that an employee with disability has equal employment opportunities such as recruitment processes, promotion and training opportunities as well as equal terms and conditions of employment.

Employees with a learning disorder may experience difficulties in the workplace such as: the need for more effort and time to read through written materials and/or process numbers; receiving and processing new and/or large amounts of information orally; adapting to changes in processes and/or duties; staying focussed for long periods without a break such as in group meetings or written work; and making oral presentations in public. These and other difficulties may become apparent at various points within the process of employment, from the initial recruitment process, such as responding to the selection criteria or participating in an interview, to engaging in particular tasks within the job.

Common workplace adjustments that may be useful to people with learning disorders include:

- presenting instructions both in writing and orally
- breaking new tasks into smaller steps
- allowing regular breaks, especially in meetings or group sessions
- allowing time for clarification and questions
- providing written materials for meetings in advance

- giving advance notice and clear information about changes at work
- encouraging the use of smartphones or PDAs, to assist with memory and planning
- providing screen-reading software (e.g. JAWS) and speech-to-text dictation software (e.g. Dragon Naturally Speaking)
- providing proof-reading assistance for written and/or number-based work
- providing professional development opportunities (mentoring, coaching or training courses) in the areas affected, such as work organisation, running meetings, oral presentations, using helpful computer software
- providing task cards which provide simple step-by-step prompts
- using 'To do' lists and checklists on a daily basis to help organise work tasks and manage time

In many instances, these adjustments are simple to implement, require relatively minor changes to processes or procedures, and often involve no financial cost to the employer. Other adjustments may require more effort and financial outlay to implement, such as the purchase of new technology or computer software (which many organisations and businesses are happy to cover). However, in the instance where the cost may be higher than an organisation is able or willing to pay, there is a government initiative which helps eligible employers or individuals with disability with these costs. The Employment Assistance Fund (EAF) provides financial support to eligible parties to buy work-related modifications,



equipment, and workplace assistance and support services. For students entering the workforce who are likely to require workplace adjustments, it is useful to be aware that the EAF is available to eligible people with disability who are looking for or about to start a job, are self-employed or who are currently working.

Sharing information regarding dyslexia

It is important for students and jobseekers to know that they are under no obligation to share details about their disability with a prospective employer and that a request for an adjustment can be made at any time throughout the recruitment process or while in the employ of a workplace. However, it may be necessary for an individual to inform their employer about their disability if it is likely to affect how they can do their job or if it will affect their ability to work safely and ensure the safety of their co-workers.

The awareness, understanding and confidence of organisations and the individuals within those organisations,

Alicia Gleeson, executive general manager, human resources, Crown Melbourne, says that workers rarely disclose learning difficulties. With many young people presenting with poor writing skills, sometimes it's a case of distinguishing whether it's a lack of ability or a disability, she says.

When dyslexia is disclosed, there are easy accommodations that can be made. "In one case, a candidate who was training with us and working in the food and beverage area was having trouble writing things down, so we used photos instead," says Gleeson.

"All of our trainers are trained in providing alternative assessment procedures, and are focused on competency-based learning. Alternatives can be oral or visual. It's about finding other ways to communicate and making simple adjustments," she says.

Crown Ability is the company's disability program set up specifically to accommodate people in the workforce. "It's really about attitude and a propensity to provide a great customer experience and most disabilities don't impact on that", says Gleeson.

Excerpt from: What You Need to Know About Dyslexia in the Workplace by Clive Hopkins

with regard to managing a disability, varies greatly from workplace to workplace. This is an important consideration when deciding if and when to share disability-related information. However, the legal protections for workers with learning disorders are better if the employer is aware of the disorder. When deciding to inform an employer of a disability, it can help to be prepared for any reactions, both positive and negative; offer any information you have about managing the disability in the workplace; and show a willingness to assist and negotiate with implementing any workplace adjustment.

When a disability is disclosed during the application process, an employer can lawfully ask a number of questions about a disability or injury. These can include:

- Any adjustments required to ensure a fair and equitable interview/selection process.
- How the person will perform the inherent requirements of a job.
- Any adjustments that may be required to complete the inherent requirements of the job.

Any other questions about an individual's disability are inappropriate, including questions about:

- How the individual acquired their disability.
- Specific details of the individual's disability.
- How the disability will impact the ability to perform aspects of the role

Additionally, any information shared with a person at work should not be shared with anyone else, unless the employee has given permission to do so. Further information on when and how to share disability-related information in the workforce can be found on the Australian Network on Disability website (see below).

Useful Resources to Support Moving into the Workforce

<https://www.humanrights.gov.au/our-work/disability-rights/brief-guide-disability-discrimination-act> - A brief guide to the Disability Discrimination Act in relation to the workplace.

<https://www.jobaccess.gov.au/people-with-disability/available-support> - JobAccess is helps people with disability find and keep jobs, get promoted to better jobs, upgrade or expand their workplace skills, and more.

<https://www.jobaccess.gov.au/people-with-disability/funding-changes-workplace> - The Employment Assistance Fund (EAF) gives financial help to eligible people with disability and employers to buy work related modifications, equipment, and workplace assistance and support services.

<https://www.and.org.au/pages/jobseeker-toolkit.html> - Australian Network on Disability. These resources are for students and jobseekers to prepare for different stages of the recruitment process.

<https://www.westernsydney.edu.au/educationtoemployment/home> - This website is about the changes that can be readily made by students, graduates, employers and those services supporting them to bring about better outcomes.

<https://edge.org.au/> - EDGE Employment Solutions is a Perth based service that believes that all people with disability have a right to work in open employment. They also run the School to Work Transition program designed to ensure students with disability transition smoothly into the workforce after school.

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South Western and Western Sydney NDC Officer Program 2013-17

Writing and Cognitive Load Theory

By Natalie Wexler

Cognitive load theory has been described as one of the most important discussions in modern psychology that educators need to be familiar with. Natalie Wexler looks at what the implications of this theory are for the way we teach writing, and what it means in the classroom.

It's been said that reading is the most difficult thing we ask students to do. In fact, that description applies more accurately to writing, which has received far less attention from both cognitive scientists and educators. Because it requires students to express themselves and not merely to receive and process information, writing imposes the greater cognitive load.

It's clear that reading places a heavy burden on short-term or working memory - the aspect of cognition that could also be called 'consciousness', and which can hold only a limited number of things for a limited amount of time. When it comes to decoding, those things include the correspondences between letters and sounds; for reading comprehension, they expand to include knowledge and vocabulary relating to the topic. The key to successful reading is to have as many of these factors as possible stored in long-term memory - which has a virtually infinite capacity - so they don't take up precious space in working memory and overload it.

With writing, background knowledge is even more crucial. It may be difficult to read about a subject that's unfamiliar, but it's virtually impossible to write about one coherently. At the same time, knowledge of the topic is only one of many factors vying for space in working memory. Even when producing a single sentence, inexperienced writers may be juggling things like letter formation, spelling, word choice, and sentence structure. When asked to write at length, they need to cope with the challenges of adhering to a topic, creating smooth transitions, avoiding repetition, and ensuring that the overall organisation of the piece is coherent. All of this is in addition to absorbing the information that forms the basis for their writing, deciding what to say about it, and anticipating what a reader will need to know.

In some situations, the key to easing cognitive load is to provide what are known as 'worked examples'. Rather than asking learners who are unfamiliar with a topic to acquire knowledge through solving problems themselves, the theory goes, teachers should have them study problems that have already been solved. In the context of maths, for example, research has shown that students who study worked examples of algebra problems perform better than those who solve problems on their own, when tested later on their ability to solve similar problems. The reason appears to be that problem solving imposes such a heavy cognitive load on novice learners that they have little capacity left for transferring the strategies they've used into long-term memory.

It's been suggested that the worked-example effect can be applied to writing as well: if teachers explicitly teach sentence structures and vocabulary, provide exemplars that illustrate these things, and lead discussions on the subject, students should be able to study the exemplars and reproduce those features in their own writing. But many American teachers already use a version of worked examples when trying to teach writing: they show students 'mentor texts' to use as models. Considering that a mere 25% of American students test at the proficient level in writing, it's fairly clear that that approach is not having the desired effect.

Showing students exemplar sentences rather than entire texts is definitely a step in the right direction, because it focuses students' attention on a manageable unit. But the problem, as Greg Ashman has put it, is that there's a difference between 'knowing that' and 'knowing how'. Students may know, for example, that a sentence is 'a set of words containing a subject and a predicate and expressing a complete thought'. Showing students examples of complete sentences and

Students don't need to learn the names of grammatical structures and parts of speech for their own sake. But certain terms are useful as a shorthand for strategies that will enhance writing and lessen cognitive load.

In some situations, the key to easing cognitive load is to provide what are known as ‘worked examples’.

contrasting them with sentence fragments may make the concept more concrete. But many students will nevertheless fail to know how to write complete sentences and continue to use sentence fragments in their own writing. A basic problem is that the massive cognitive load that inexperienced writers face makes it difficult for them to remember to put their conceptual knowledge into practice.

How do we get students to know how to write well? That question is crucial, and not just because we want students to acquire writing skills. When the cognitive load is modulated, writing is perhaps the most effective way to build and deepen students’ knowledge and develop their analytical abilities. To be sure, students need some knowledge of a topic to begin writing. But once they start to write, they need to recall information they have recently learned, determine which points are important and connect them to one another, and put all of this into their own words. If students have the cognitive capacity to engage in these steps, the effect is powerful - akin to the ‘testing effect’ (the boost in retention that comes from being quizzed on recently learned material) and the similar ‘protégé effect’ (which results from explaining a topic to another person).

Because of the complexity of the writing process, students need more than direct instruction and worked examples to become competent writers. They need ‘deliberate practice’: repeated efforts to perform aspects of a complex task in a logical sequence, with a more experienced practitioner providing prompt and targeted feedback. And for many students, including many at upper year levels, this kind of practice needs to begin at the sentence level - partly because sentences are the building blocks of all good writing, and partly because sentence-level tasks lighten the cognitive load. That’s not to say that constructing a sentence is an inherently simple task. It all depends on the content. For example, there’s nothing simple about completing this sentence: ‘Immanuel Kant believed that space and time are subjective forms of human sensibility, but _____.’

Deliberate practice in writing also needs to extend beyond English class to the rest of the curriculum. Not only does that provide teachers of history, science, maths, and other subjects with a powerful tool to enhance their instruction, it also gives students more opportunities to practice the writing strategies. Eventually, many of those strategies will become lodged in long-term memory, becoming so automatic that students don’t even realise they’re using them.

When students are ready to embark on lengthier writing, where the cognitive load is even greater, they need to learn to construct clear, linear outlines that enable them to organise their thoughts, avoid repetition, and stay on track. Juggling those tasks in working memory while writing can be overwhelming even for many experienced writers. Once students have used an outline to create a draft, they can use their pre-existing knowledge of sentence-level strategies to vary their sentence structure and create smooth transitions.

While this approach to writing is still rare and unorthodox, it is gaining traction largely thanks to a US- based organisation called The Writing Revolution, of which I am board chair, and a book that explains the method - also called The Writing Revolution - of which I am the co-author with Dr Judith C. Hochman. A veteran educator, Dr Hochman has developed a series of writing strategies that are designed to be taught explicitly and practiced repeatedly in a variety of contexts, with prompt feedback from a teacher. Although originally created for learning-disabled students, the method has been shown to be effective with students of all abilities, including those still learning English.

What does the method look like in practice? Let’s return to the example of students who use sentence fragments rather than complete sentences. In addition to showing students examples of fragments and complete sentences side by side, the Hochman Method has students practice distinguishing between the two - and turning the fragments into complete sentences. For older or more sophisticated students, the terms ‘subject’, ‘verb’, and ‘predicate’ might be used, but it’s sufficient to simply ask questions in functional terms. For example, if a fragment says, ‘ate a great meal,’ the teacher might ask the class, ‘Does that tell us who ate a great meal? How can we make these words into a sentence?’

To derive the maximum benefit from this activity, the examples should be embedded in whatever content students are learning. A maths teacher who has taught rational numbers could review - and simultaneously build writing skills - by giving students the following fragments and asking them to transform the phrases into sentences, with proper punctuation and capitalisation:

- can be expressed as a fraction or a ratio
- rational numbers

Their responses might be:

- A rational number is a number that can be expressed as a fraction or a ratio.
- Rational numbers can be ordered on a number line.



Eventually, through the repeated process of identifying and correcting fragments, students will develop an understanding of how to create a complete sentence and apply that knowledge to their own writing.

Students don’t need to learn the names of grammatical structures and parts of speech for their own sake. But certain terms are useful as a shorthand for strategies that will enhance writing and lessen cognitive load. For example, the method has students learn the word ‘appositive’ - that is, a phrase that renames a noun - because it provides them with an effective strategy for varying sentence structure and expanding their responses. Once students have grasped the concept, they can be asked to provide appositives for sentences grounded in the content of the curriculum. A biology teacher might give students the sentence, ‘Natural selection, _____, results in species with favourable traits.’ A student might supply the appositive, ‘a process of evolution’.

When students have moved on to lengthier writing, they’re advised that

appositives can be used to create good topic sentences - and they’ll understand what to do. Ultimately, that information will be stored in their long-term memory, along with the knowledge of other possible sentence types and structures, to be drawn on when beginning a paragraph or an essay. Rather than having their working memory occupied with searching for a way to begin - or, if they’re revising an essay, to vary their sentences - they’ll be able to devote more cognitive capacity to what they want to say.

Those of us who are already competent writers have vastly underestimated the difficulties faced by many (if not most) students in reaching that point. In years past, the assumption was that teaching rules of grammar and parts of speech was sufficient. After studies determined that approach had no positive impact on student writing, and in some cases had a negative one, another school of thought took hold. Its proponents assumed students would basically pick up the conventions of written language if they just

read enough mentor texts and engaged in enough writing. Given the generally dismal results, it’s time for a new approach, supported by research: explicit instruction, mentor texts or ‘worked examples’, and the deliberate practice that will enable students to transform their conceptual knowledge into knowing how to write. Not only will schools produce better writers, but easing the cognitive load imposed by writing will lead to better thinking as well.

Natalie L. Wexler is an education journalist, novelist, and historian. She is the author of *The Knowledge Gap: The Hidden Cause of America’s Broken Education System—and How to Fix It*, and co-author, with Judith C. Hochman of *The Writing Revolution: A Guide to Advancing Thinking Through Writing in All Subjects and Grades*.
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