Kids learn best when you add a problem-solving boost to 'back-to-basics' instruction

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Credit: Katerina Holmes from Pexels

Last year there was substantial hand-wringing over Australia's declining results in the Programme for International Student Assessment (PISA) tests. Ideas for how to reverse this decline were coming from far and

wide, thick and fast.

Federal Minister for Education Dan Tehan declared Australian education needed to go "back-to-basics" while influential commentators pointed out PISA tests are focused on "problem-solving" and this is what we need more of in Australian schools.

Of course, both views are correct. The problem is they are often framed as mutually exclusive, when in fact we can effectively teach the basics and optimize problem-solving at the same time.

Our recent research suggests "load reduction instruction" is one way to do this. To explain load reduction, we must first explain a bit about memory.

Short and long-term memory

There are two key parts of the human memory system: working memory and long-term memory.

Working memory is the in-the-moment component that receives and sends information to long-term memory. It is limited and estimated to hold information for about 15-20 seconds, with a capacity about the size of a phone number.

Long-term memory has vast capacity and indefinite duration. The teacher needs to help students build up their long-term memory such as fundamental facts and rules (times-tables) as well as concepts and procedures needed for performing more complex tasks (difficult algebra).

Teachers need to teach in a way that reduces the burden on students' working memory when they are learning new content or skills. If

working memory is overloaded, students may misunderstand information or not understand it at all.

Explicit instruction is a good way to ease this burden when students are learning the basics. Here, for example, a teacher clearly and systematically shows the students what to do and how to do it.

Once students understand the basics, they can take on more complex information. In fact, research has shown if students are not moved onto problem-solving opportunities after they have learned the basics, their learning can decline (this is called the "expertise reversal effect").

Fostering problem-solving can be done through guided inquiry-oriented learning. Here the teacher may assign a more open-ended or complex task students complete on their own using, or inferring from, the information and skill they gained in the explicit instructional phase. It is "guided" because the teacher still has a role in monitoring progress and assisting as appropriate.

What is load reduction instruction?

Load reduction instruction aims to integrate explicit instruction and guided inquiry with the following five principles:

1. make tasks simple enough to suit the students' existing knowledge or skill level at the start of the learning process. The teacher could do some pre-testing to understand what the students already know and then present information and tasks at a level of difficulty that matches the students' ability
2. instructional support from the teacher through the task. The teacher could provide a task for students to do in steps and work closely with them through each one
3. structured practice and repetition. After working through a task

with students, the teacher could give similar tasks where students can practice what they know or can do
4. feed-back and feed-forward. The teacher could provide corrective information (if correction is needed) and specific suggestions for the student to apply or to improve on the next task
5. guided independent practice, problem-solving and inquiry-oriented learning. The teacher could provide a more complex task students do on their own and that may involve more than one path to a solution or more than one solution. The teacher's guidance is minimal (such as reminding students of the likely steps involved or providing some hints when students get stuck), but always available.

The first four principles may be considered the "back-to-basics" parts of load reduction instruction and rely on the more traditional explicit approaches. Then, as core skill and knowledge develop, the fifth principle is emphasized: problem-solving.

How we know it works

We have conducted two studies exploring load reduction instruction in class. The first study involved 393 high school students in 40 maths classrooms.

Students rated their maths teacher on five aspects of each of the five principles described above.

Students also reported on their own motivation and engagement in maths, their academic buoyancy in maths (how well they bounce back from academic setback), and their maths achievement. We found the more the teacher was reported to implement load reduction instruction, the higher their students' levels of motivation, engagement, academic

buoyancy and achievement.

In a second study (currently under peer review), students from more than 150 science classrooms rated their science teacher using the five principles. Students also rated their own engagement in science (how much they enjoyed and participated in class) and completed a brief science test.

Our analyses revealed students who were taught using load reduction principles had higher levels of engagement in science and higher levels of science achievement.

Back-to-basics and problem-solving should go hand in hand. The success of one is inextricably tied to the success of the other. But the order in which things are done is critical. Explicit instruction must first be used to ease the load on students as they learn the basics. Then, when some expertise has developed, students move to guided inquiry to nurture their problem-solving capacity.

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