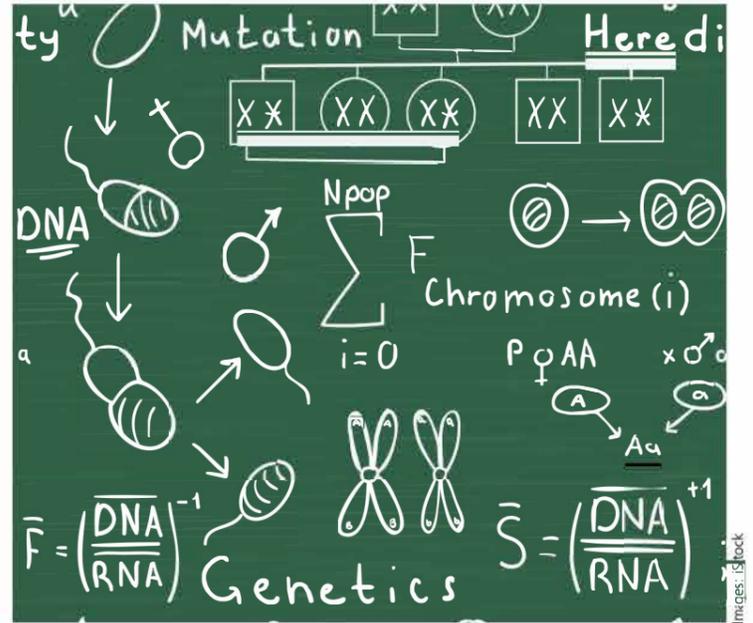
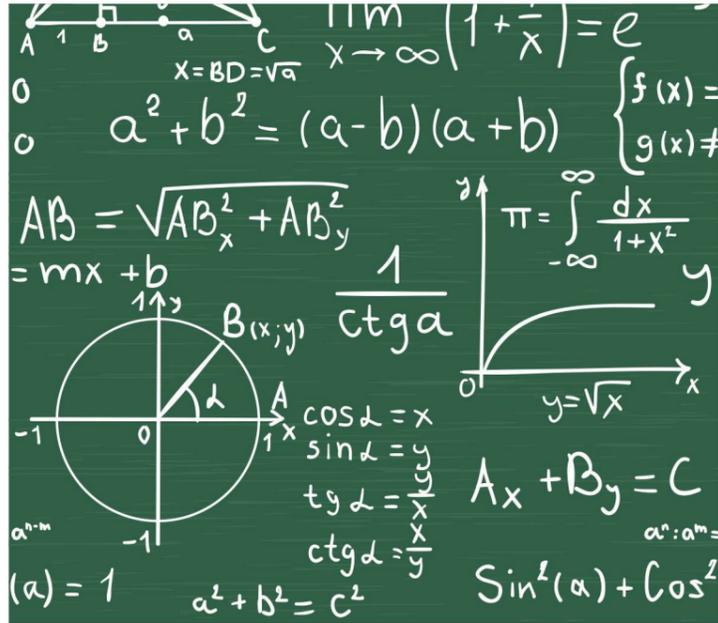


Three new reports offer a range of teaching and learning strategies in maths and science, all based on international evidence. **Dorothy Lepkowska** takes a look

Teaching strategies for maths and science



International comparisons in performance between countries can tell us many things. Apart from the obvious – how we stand in core subjects in relation to other countries around the world – they may offer some insights into what teachers are doing right in the classroom, and what can be improved.

The National Foundation for Educational Research (NFER) has recently published a series of three reports, commissioned by the Department for Education (DfE) offering strategies that teachers might use to improve teaching and learning in the classroom.

These were based on analyses of the OECD's Programme for International Student Assessment (PISA) findings for 2012, with input from a range of leading practitioners and experts in classroom practice.

Tackling low performance in maths

From previous PISA reports we know, for example, that achievement in mathematics in English schools is not significantly different from international averages, though the gap between the most and least able is relatively wide.

Among the lowest performers are girls, pupils from disadvantaged backgrounds and those who are eligible for free school meals, and youngsters with special needs.

The report, *Tackling Low Performance in Maths*, finds that pupils who displayed lower levels of perseverance with maths were much more likely to be low performers in the subject. So equipping them with strategies to help them tackle difficult tasks and problems can be important in supporting them to achieve.

It is important for teachers to establish what pupils already know, but avoid direct question and answer sessions at the beginning and end of lessons as this can discourage lower achievers and promote disengagement

Leading practitioners recommend that one way of tackling low performance is to link maths to everyday activities so that it is meaningful and relevant, to promote engagement. If pupils understand why they are learning it and have some context to what they are learning, then they are more likely to persevere.

The report notes that "pupils tend to become more involved when they have been supported to guide their own learning, rather than when expectations are determined solely by the teacher".

It continues: "As a teacher this means continuously looking for specific ways to involve pupils in effective dialogue and to support them in this way in investing in owning and developing their own learning."

It is important for teachers to establish what pupils already know, but avoid direct question and answer sessions at the beginning and end of lessons as this can discourage lower achievers and promote disengagement.

Effective teaching and learning, the report adds, takes places where there is discussion, analysis and reflection, and the teacher differentiates tasks and activities so that learners of all abilities are supported.

Some pupils, for example, may thrive by working in groups where they can share their perceptions and insights with others, and learn from the views and opinions of their classmates.

All of these methods can engage learners more fully and so reduce low performance, not only in individual classes but throughout the school as a whole. Among the whole-school approaches to consider when trying to improve motivation and engagement might be the appointment of "learner engagement" champions – members of staff responsible for exploring good practice in this area within the school.

Schools may also ask some members of staff to research a range of engagement strategies and then feed back to colleagues on their effectiveness.

Cognitive activation in maths

Some of these strategies are explored further in the report *Cognitive Activation in Maths*, another of the documents in the series, which examines methods that encourage students to think more deeply about mathematics and how they find solutions to problems. The aim of this approach is to focus on the workings and method used to achieve the correct answer, rather than focusing on the answer itself.

Cognitive activation requires pupils to link new information to what they already know. In making connections between mathematical facts, ideas and procedures, it is hoped they will achieve enhanced learning and a deeper understanding of the concepts. The method has been found to aid learning and achievement across all abilities and socio-economic groups of pupils.

Deviating from tried and tested teaching methods can feel risky to some teachers, but the report contains some short, medium and long-term strategies aimed at introducing cognitive activation as a tool for teaching and learning.

For example, a maths problem being explored in the classroom can be related to a real-life scenario by asking questions such as "how would a mathematician tile my bathroom?" or "how would you work out if there was enough food for everyone in the world?"

Lessons could be punctuated with questions like "what if...?" or "does everyone think that...?", which might prompt pupils to explain how they arrived at a particular method, or to think of an alternative way to solve the problem. By working in small groups, students can also be encouraged to share and develop ideas.

In the medium and long-term, students can be asked for input into what strategies they found most effective, and similarly teachers can gather evidence to show the same. Over time, colleagues working in different subject areas could find links between them. For example, maths and geography departments could instigate a project to plan the layout of a town to minimise travel by residents to key locations.

Science and problem-solving

One area where England's average performance exceeds the international average is in science and problem-solving assessments. Only 10 countries performed better in the PISA science assessment, and only seven in problem-solving. It was also found that, overall, England had a greater proportion of high achievers compared with the international average.

It is here that important lessons might be learned about how improved performance might be achieved, with the evidence suggesting, once again, that there was a positive relationship between performance and pupil engagement.

The findings from the report, *What We Can Learn from England's High Performance in Science and Problem-solving?* suggest that, in general, "good attendance and a positive attitude towards school are strong indicators of the likelihood of a pupil being a high performer" and that the strategies employed by teachers in the classroom were a significant factor in promoting engagement both with learning and the school.

"It is therefore important to consider the pedagogical approaches that can be adopted by teachers in all subjects to increase the engagement of pupils of all abilities," the report states. Experts have found that adapting teaching to real-life situations helps pupils and students

to understand that what they were learning is relevant now and in the future.

They suggest that teachers consider making learning meaningful by showing pupils how it relates to their own lives. This might involve looking at their future careers and inviting employers in to deliver some of the content.

Enrichment and enhancement activities might also offer opportunities to those pupils who were particularly interested in science and wanted to know more about it.

Teachers should also listen to students, the report states, to find out what they already know and invite them to ask questions that might be addressed in future lessons. Open-ended tasks would allow young people to use their initiative and to be creative in their learning –

rather than working on activities designed to produce a right answer.

In order to achieve all of this, schools need to support teachers with CPD. The report says that staff who possess expert and up-to-date subject knowledge are "better equipped to support and encourage pupils' learning". Similarly, developing links with employers often helps to improve learning outcomes.

• Dorothy Lepkowska is a freelance education writer.

Further information

The three reports, published by the NFER in September 2015, are available via <http://bit.ly/1LYJd5O>


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