THE SCHOOL EXPERIMENT

COVID-19 caused the largest disruption to education in history. But research has identified effective ways to help children catch up. **By Helen Pearson**

By October last year, Meg Brydon could see the terrible toll the pandemic had taken on children at her school. Brydon was a teacher at Ashwood High School, in the suburbs of Melbourne, Australia — the city that has spent more time in COVID-19 lockdowns than any other in the world. The school had been closed, on and off, for about seven months.

Before the pandemic, around 10% of children who joined Ashwood at the age of 12 would be below the expected national standard. But in the latest cohort, Brydon could see that a shocking 30% of them were behind. And the damage ran even deeper. So many children had behavioural or psychological problems after lockdowns that some were getting violent, and the school hired a full-time psychologist to help. "The number of referrals to her was astronomical," Brydon says.

Similar scenarios have played out in classrooms around the world. By February this year, schools globally had been closed because of COVID-19 for an average of 4.5 months, affecting an estimated 1.6 billion students and creating what the United Nations has called the largest disruption to education in history. Even 2 years into the pandemic, 48 countries had not yet fully reopened their schools, according to the UN cultural organization UNESCO.

The consequences of these closures follow a sad but predictable course. In rich countries, disadvantaged and vulnerable children have fallen behind the most. Those in poorer countries have been the hardest hit, and millions will never go back to school at all. UNESCO estimates that today's generation of students could lose US$17 trillion in lifetime earnings at current values because of missed learning and skills. "We're really talking about a generational loss," says Margarete Sachs-Israel, who leads the Inclusive Quality Education Section at UNESCO in Bangkok.

Now, governments and schools need to know the best approach to help children catch up — and research could show the way. Over the past 20–30 years, researchers in education, economics and international development have built substantial bodies of evidence, including banks of randomized controlled trials, showing strategies that are effective at boosting school attendance and learning. They reveal, for example, that tutoring is one of the most cost-effective ways to help children to make up lost ground. And some countries are drawing on this evidence in their COVID-19 responses, putting a focus on tutoring and other programmes that educational studies have shown to be effective.

But experts point to a number of concerns. The true extent of learning losses in the pandemic is not yet clear; educational research rarely provides simple answers about what to do; and nations might not use this opportunity to make much-needed systemic change. "Every single time there's been a calamity in the world, we've rushed back to the old normal fast," says John Hattie, an educational researcher at the University of Melbourne. "The biggest travesty of COVID is if we learn nothing."

What's more, the scale of the task ahead is immense. Researchers and education experts are concerned that the amounts being invested are laughably insufficient, given the number of students who need help. "It's a real test for the global community," says Kenneth Russell, an education specialist at the UN children's charity UNICEF in New York. "And I don't think the magnitude of the response matches the magnitude of the need."

Even so, the pandemic could eventually drive some transformative changes in education — ones that both improve practices and reach more students, researchers say. "I do think it has thrown into the air many of the assumptions that we make about education," says Lee Elliot Major, who studies social mobility at the University of Exeter, UK.

Tough sell

The concept of using research in education has been a long, tough sell. "The fundamental issue is that many practitioners do not believe it will ever be a science," says Andreas Schleicher, who heads the directorate for education and skills at the Organisation for Economic Co-operation and Development (OECD) in Paris. Teachers are not expected to browse academic journals, and educational policies are often set by the ideology of bureaucrats rather than by research showing what actually works. "Many of them use evidence to confirm what they want to do," Schleicher says.

Some researchers and educators have been

Students in India in March; schools there were closed for months earlier in the pandemic.

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trying to change that view for decades. They want education to operate more like medicine, where a drug typically has to be proven effective in randomized controlled trials before it's used. Advocates of evidence-informed education argue that teaching and learning methods should also be shown to work by research — rather than being used because of tradition, opinion or the latest fad. But they acknowledge that testing whether a method improves educational outcomes is often more complex than testing whether a drug improves health.

In late 2010, evidence-informed education got one of its biggest boosts when the UK government invested £125 million (US$156 million) to raise standards in schools. This gave rise to the Education Endowment Foundation (EEF), a non-profit organization in London that has since become a leader in educational research. It has funded at least 160 randomized controlled trials in education, probably more than any other organization in the world. Around half of English schools have taken part in these trials. The investment in the EEF "had a ripple effect around the world", says Annette Boaz, who studies evidence and policy at the London School of Hygiene & Tropical Medicine.

Other databases of educational research have flowered, too. Hattie led an early, pioneering project to synthesize evidence from around the globe on what influences learning[1]. And, the US Department of Education's Institute of Education Sciences in Washington DC maintains the What Works Clearinghouse, a source of information on educational programmes that have been shown to be effective through rigorous research. Hattie argues that with databases such as these, the field doesn't need more evidence — the challenge lies in getting the information used by governments and schools. "We're hopeless at that," he says.

The pandemic could, in theory, help to bridge that gap. Countries worldwide want to know the best way to invest in educational recovery, and billions of dollars are already pouring into schools. "This moment in time really is a unique one, for changing the conversation about evidence in education," says Nancy Madden, a psychologist and researcher at Johns Hopkins University School of Education in Baltimore, Maryland. "People want something that works, they aren't just doing business as usual."

Dismantling dogma

The crown jewel at the EEF is its Teaching and Learning Toolkit, which is based on systematic reviews and meta-analyses of studies, such as randomized controlled trials, that have tested 30 educational approaches. The toolkit translates findings into an easy-to-understand metric: the number of months of additional progress achieved over a year, on average, by children who receive an intervention, compared with similar children who do not. It also displays the strength of the underlying evidence and the intervention's cost (see 'Which educational techniques get top grades?' and go.nature.com/3nbhdzm).

The toolkit dismantles many common beliefs by showing that modest reductions in class size (from 30 to 20 students, for example), wearing school uniforms and grouping children according to attainment level have little if any effect, on the basis of the evidence so far. The most effective strategies include ones that help children to understand what they read; giving them meaningful feedback; and approaches that improve meta-cognition — the ability of students to think about, plan and evaluate their own learning. These each give children six or seven months of progress, on average.

More than 70% of secondary-school leaders in England now use the toolkit when making decisions about how to spend funding. The EEF has partnered with groups to adapt it for use in Australia and parts of Latin America, the Middle East and Africa.

Long before the pandemic, it was clear that one of the most cost-effective approaches is tutoring, either in small groups or one-to-one. The toolkit says this can buy four to five months of additional progress at relatively low cost. And, unlike some other effective methods, tutoring programmes can be ramped up and implemented quickly. So, in 2020, the EEF rapidly reviewed evidence on the possible impacts of the United Kingdom's nationwide school closures[2] and highlighted that tutoring was likely to be a particularly effective way to help children to catch up. At the time, "tutoring seemed such a plausible response", says Becky Francis, an education researcher who is chief executive of the EEF. The recommendation "landed in a void at the time and was seized upon eagerly by policymakers", she says.

In June 2020, the UK government announced a £350-million National Tutoring Programme as part of its wider £1-billion catch-up funding for children. (The EEF was one of several partners that ran the programme for the first year; the Dutch company Randstad took it over in

the second year.) But the tutoring programme has been widely criticized for drastically failing to reach enough children, in particular those who stand to gain most from it. "I think it hasn't targeted the most disadvantaged pupils properly. It hasn't won over teachers," says Elliot Major. "And partly that's because there's some scepticism about variation in the quality of the tutors."

This March, the government ended Randstad's contract and announced that funding for tutoring would go directly to schools in the 2022–23 academic year. The National Foundation for Educational Research in Slough, UK, is conducting independent evaluations of the tutoring programme's impact on student attainment.

Both the EEF and Randstad say they are proud of what they achieved with the tutoring programme. In statements to *Nature*, the EEF said that 60% of secondary schools had accessed tutoring by July 2021, and Randstad said it had tripled the number of students in the tutoring programme.

Case studies

Another evidence-backed programme has been widely, and less controversially, put in place in England. The Nuffield Early Language Intervention (NELI) has been shown in randomized controlled trials to boost language skills in children aged 4–5 through a series of teaching sessions in small groups (see go.nature.com/39xtgsk). NELI is now being used in two-thirds of English primary schools to help make up for learning missed during the pandemic, and its results are being independently evaluated. "Although it's had a tremendous reach, it's flown almost entirely under the radar," says Francis.

Some researchers point to the Netherlands as having taken an exemplary approach to education recovery based on evidence. There, the government handed €4.2 billion (US$4.4 billion) of funding to schools to support students, and required that they spend it by picking from a 'menu card' of evidence-based approaches largely based on the EEF's toolkit. "We want to make sure as much as possible that schools will base their decisions on knowledge that's available on effective approaches," says Femke Bink, senior adviser in the Department for Secondary Education at the Ministry of Education, Culture and Science in The Hague.

And in Panama, where schools were fully closed for more than a year, the Ministry of Education in April launched resources and training for teachers showing how to implement evidence-based practices, including feedback to students. "Teachers are tired and stressed, so we're trying to say to them, 'we want to channel your efforts into what really works'," says Javier González, director of SUMMA in Santiago, Chile. SUMMA aims to improve education systems in Latin America and the Caribbean using research, and helped to develop the training.

The United States, too, has put some emphasis on evidence in its recovery plans. In 2021, a giant stimulus bill channelled $122 billion to schools. The law requires that at least 20% of funds received by districts must be used on evidence-based measures to help students' academic, social and emotional needs. In practice, however, it's hard to know how this money is being used, says Mike Petrilli, president of the Thomas B. Fordham Institute, an educational foundation in Washington DC. "Based on past experience, we should expect that much of the money will not be spent in the best way."

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Another complication is that tutoring comes in many styles: one-to-one or small groups; online or in person; delivered by human teachers or digital ones. There is no guarantee that a particular programme will be effective, or that it will be successful in a particular school or for a certain child. "It's not just hiring some people that call themselves tutors and putting them in the room with some kids — you can waste a lot of money that way," Madden says.

In Melbourne, Brydon saw the challenges of putting a tutoring programme in place. Her school was able to place an extra teacher in some classrooms to help children who have fallen behind, using money it received as part of a catch-up programme from the government. But the school is struggling to find teachers to fill positions, she says, because exhausted colleagues are quitting their jobs. "We need upwards of ten substitute teachers every day just to keep the school running," she says.

Global problems

Things are looking even grimmer elsewhere in the world. UNESCO estimates that, by April 2020, more than 1.2 billion children in the highly populous Asia Pacific region had been affected by school closures. And, whereas schools closed in Japan and Singapore for only a month or so, those in Bangladesh and the Philippines have experienced some of the worst disruptions in the world, with schools fully shut for more than 13 months.

Even before COVID-19, there was a learning crisis in the region, Sachs-Israel says, because so many children did not achieve expected proficiency levels at school. An estimated 10 million children in the Asia Pacific region will not go back to school, and the expectation is that early or forced marriages and child labour are expected to soar.

The scale of this problem is not one that extra tutoring alone can address. With many schools still closed, the obvious top priority, say education specialists, is for classes to reopen so that children can return — even if COVID-19 cases start rising again. Sachs-Israel says schools have to be welcoming and safe, and need to overcome any fears that parents, teachers and children might have about infection risks.

According to a 2020 report[3] from an international group called the Global Education Evidence Advisory Panel, one cost-effective approach for schools is to target teaching to a child's learning level rather than to their age. And education researchers say that schools should assess each returning student.

This is the strategy behind an evidence-based programme called Teaching at the Right Level, run by the learning organization Pratham in New Delhi. The organization's chief executive, Rukmini Banerji, says it is working with several state governments in India and other countries, and has observed that children are making progress in basic literacy and numeracy in just a few weeks. "We feel that is what is really needed across the world," she says.

Questioning the evidence

Even with all the support for use of evidence in education, there have been some long-standing concerns about how reliable some of that evidence is. In 2019, a pair of researchers examined 141 large randomized controlled trials commissioned by the EEF and the US-based National Center for Educational Evaluation and Regional Assistance. They concluded that 40% of the trials were uninformative because their effects were small or imprecise[4]. "So at the beginning, you didn't know whether the intervention works or not. But at the end, we're still unsure whether it works," says study author Hugo Lortie-Forgues, who studies mathematics education at Loughborough University, UK. This could be because early, promising research on an approach turned out to be misleading, a method was hard to scale up or the trial was poorly designed, he says.

This was no big surprise to researchers who conduct such studies. Just as most new drugs prove ineffective in large clinical trials, most bright ideas for improving learning show little effect when they are put to the test. And whereas in medicine, physicians start with someone who is ill and try to make them measurably better, in education, many countries are starting with a fairly healthy education system — so any new method is likely to produce only marginal gains. "It's perhaps a little naive to assume that teachers haven't discovered, over time, some of the approaches that are more likely to be successful," says Steve Higgins at Durham University, UK, who has led work on the EEF's toolkit.

With data still rolling in, there are some suggestions that school closures might have had a smaller impact on some children's achievement than many doom-laden headlines suggest — or

that students might bounce back quickly. When Hattie examined the effects of school closures in Victoria, Australia, where schools (including Brydon's) had been closed for extended periods, he concluded that it was surprising that learning trajectories had only marginally decreased (see go.nature.com/3mtxucq). One possible reason is that some students working alone were able to be more efficient than at school. Schleicher adds that technology also became more accepted, teachers rallied to support children socially and emotionally, and parents became more involved in their children's education. Looking at the overall impacts of the pandemic on education, he says, "the balance sheet has pluses and minuses".

In the longer term, a key way to get research used in education more routinely will be to weave it into teachers' training and continuing professional development. One model comes from Japan, where teachers have for decades conducted 'lesson study'. This is a form of research in which they develop a goal — to improve understanding of fractions, say — then write a detailed lesson plan, observe the lesson in action and discuss what they learnt. Schools draw on external research and often consult an academic in the process. This type of ongoing professional development is unusual, says mathematics education specialist Toshiakira Fujii at Tokyo Gakugei University. Teachers develop a deep understanding of teaching materials "but more importantly they learn how to learn as a teacher".

Other countries are starting to integrate evidence into teacher training, too. The EEF and SUMMA are working with the University of West Indies at Cave Hill, Barbados, to train teachers in evidence-based practices such as giving effective feedback to students. And starting this year, all 650 students enrolled in the master's in education at Harvard Graduate School of Education in Cambridge, Massachusetts, will have to take a course on evidence, says Carrie Conaway, who is a senior lecturer there. "The idea is that we have a generation of leaders who understand the value of this as part of their decision-making," she says.

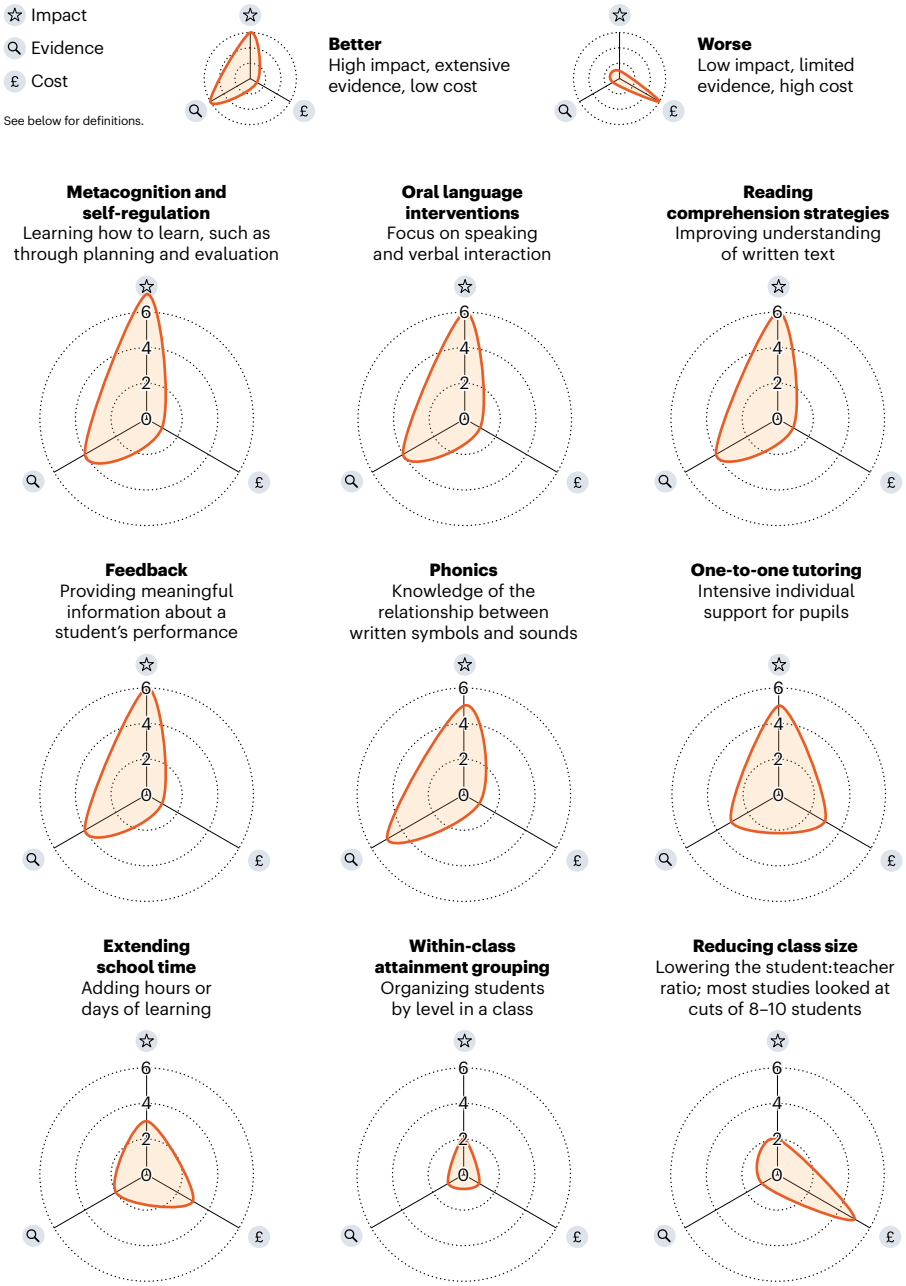
Brydon says she was taught almost nothing about using research evidence during her training — "you get exposed to a couple of major theorists and then that's really it". But she is now part of Q Project, an effort in Australia to improve the use of evidence in schools. She thinks that the biggest barrier, however, is a lack of time. "We're so swamped, and when you have to decide between getting your year-12 essays marked or reading some research evidence, I know which one I'm going to choose every day of the week."

Right now, Brydon and her colleagues are still battling to help children to catch up, amid simmering concerns that the next coronavirus variant could shut schools all over again. When people used to ask Brydon about her work, she'd tell them that teaching is the greatest job in the world. But now, for the first time, she has a different response. "There are some parts that I really love," she says, "but other parts that are making it really hard to do the job."

Helen Pearson is an editor at *Nature* in London.

WHICH EDUCATIONAL TECHNIQUES GET TOP GRADES?

The Education Endowment Foundation, a UK charity, has systematically reviewed evidence supporting many educational approaches. Its Teaching and Learning Toolkit for schools rates each technique on the basis of its cost, how much it improves student achievement and the strength of evidence supporting it.



Impact: Number of months of progress made over a year, on average, by children who received the intervention, compared to similar children who did not.

Evidence: The robustness of the evidence, based on the number of studies supporting each intervention and their rigour. 1 = at least 10 studies (very limited evidence); 2 = 11–24 (limited); 3 = 25–44 (moderate); 4 = 45–69 (extensive); 5 = 70 or more (very extensive).

Cost: Estimated cost of each intervention per student per year. 1 = less than £80 (US$99); 2 = up to £200; 3 = up to £720; 4 = up to £1,200, 5 = more than £1,200 (see go.nature.com/3nbhdzm for full details).

SOURCE: EEF

1. Hattie, J. *Visible Learning: A Synthesis of Over 800 Meta-Analyses Relating to Achievement* (Routledge, 2008).
2. Education Endowment Foundation. *Impact of School Closures on the Attainment Gap: Rapid Evidence Assessment* (EEF, 2020).
3. Global Education Evidence Advisory Panel. *Cost-Effective Approaches to Improve Global Learning* (World Bank, 2020).
4. Lortie-Forgues, H. & Inglis, M. *Educ. Res.* **8**, 158–166 (2019).