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Getting the most out of Gonski 2.0: The evidence base for school investments

Blaise Joseph

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Any errors or omissions remain my own.

Executive Summary

- Spending on schools in Australia has increased significantly in recent years while literacy and numeracy results on international tests have declined.
- The focus of education policy solutions must shift from 'spend more money' to instead using funding to invest in cost-effective, evidence-based policies and practices.
- The quality of research underpinning particular policies and practices must be considered. Not all evidence is equally reliable. School investments supported by rigorous research should be prioritised.
- Australian teachers already attend professional development activities relatively often, but the teaching practices they learn are not necessarily evidence-based, as most states and territories do not have accreditation standards for professional development providers.
- There are three evidence-based investments schools should consider:

  1. Early literacy and numeracy.
     - Intervention to help students who are underachieving in literacy and numeracy is more effective in early primary years than in later schooling.
     - Phonics are an essential part of the required measures to effectively teach reading, but are not consistently practiced in Australian schools.
     - Teacher education degrees do not equip graduates with the language knowledge necessary to effectively teach reading.
     - Primary school teachers could be helped by attending professional development specifically to improve teaching of reading and phonics instruction, which could be paid for — in full or in part — by prioritising this over other less important professional learning.
     - Better and more consistent teaching of phonics could help disadvantaged students, such as students with disabilities and students from non-English speaking backgrounds, in particular.
     - Schools should prioritise investing in early specialist support staff and evidence-based programs to help underachieving students.
  2. Give teachers fewer classes and more time outside the classroom.
     - Australian teachers spend more time each day teaching in class, relative to the OECD and the top-performing countries.
     - Lesson planning, refinement, reflection, and review have significant positive effects on teaching quality and student outcomes.
     - New teachers in particular do not have sufficient time to effectively plan lessons and collaborate with other teachers.
     - It would be beneficial to give teachers fewer classes each day so they can have more time outside the classroom to improve their teaching.
     - The extra cost of this approach would be minimal if it was offset by various options, such as larger class sizes or making teaching hours more proportional to teacher experience.
  3. Classroom management professional development for teachers.
     - Australia has high levels of classroom misbehaviour compared to the OECD and high-performing countries, especially among students from lower socio-economic backgrounds.
     - Classroom misbehaviour has significant negative effects on student achievement and can be ameliorated by effective classroom management techniques.
     - Australian teacher education degrees do not adequately prepare teachers with evidence-based classroom management practices.
     - Teachers could benefit from attending professional development specifically to learn and foster evidence-based classroom management techniques, which would not require substantially more funding if it was prioritised over less important teacher development.
- There are two common school investments that are not supported by sufficient evidence to justify significantly more spending.

  1. Smaller class sizes.
     - Australian class sizes are not especially high relative to the OECD or the top-performing countries.
     - Class size reduction appears to have limited positive — and inconsistent — effects on student achievement. Further, investments to reduce class sizes are not cost-effective.
     - Smaller classes also have the potential to dilute teacher quality.
     - More evidence would be required to justify significant investments to reduce class sizes.
  2. Technology.
     - Australian schools already use technology significantly more than most of the OECD and high-achieving countries.
     - The positive effects of education technology are inconsistent, depending on a range of factors.
     - Investments in technology have the potential to be expensive and become obsolete quickly.
     - There is insufficient evidence to suggest investing more in classroom technology would boost student achievement.
- If schools do not invest in evidence-based policies and practices, the additional Gonski 2.0 funding is unlikely to improve student outcomes.

Introduction

In the 10 years to 2015, real total government funding per student in Australia increased by 15.4%.[1] Over the same period, Australia's performance in international literacy and numeracy tests declined.[2] This shows there is no clear link between school funding and student outcomes at the national level.

The federal government's 'Gonski 2.0' plan involves an additional $23.5 billion between now and 2027, representing a 75% increase in federal school funding over that period.[3] Acknowledging that previous significant funding increases did not lead to better academic outcomes, the government's focus is now shifting from the amount of money spent to how it can best be spent.[4]

An expert panel led by businessman David Gonski — who chaired the 'Review of Funding for Schooling' in 2011 (the first 'Gonski report') — will conduct the 'Review to Achieve Educational Excellence in Australian Schools'.[5] This Gonski 2.0 review's primary focus will be reviewing evidence and making recommendations on the most effective teaching and learning strategies to improve student outcomes in Australia.[6]

A more sensible policy approach would have been to conduct the Gonski 2.0 review first, determining the evidence-based policies and practices on which funding should be spent, and then decide how much funding is needed to implement them. Nevertheless, given the substantial increase in funding has now been legislated, the task of maximizing the return on school investments is even more crucial.

Federal and state school funding models allocate money to individual schools and school systems, which generally can then spend the money however they wish. As part of the Gonski 2.0 policy, more than 99% of schools will be receiving more federal funding per student over the next 10 years.[7] It is imperative this extra funding is spent as effectively as possible to improve Australia's falling literacy, maths, and science results.

In order to generate return for additional significant school investments, it is vital schools spend the money on evidence-based policies and practices. Conversely, common school investments for which there is not sufficient evidence should be lower on the list of schools' spending priorities. Otherwise, there is a risk that in 2027 Australia's literacy and numeracy results would have continued to decline despite significantly more government spending. This would be unfair to students by not giving them the education they deserve, and unfair to taxpayers by not generating a return for their money.

The meaning of 'evidence-based' education policy

While increasingly the notion of 'evidence-based' is rightly becoming a cornerstone of education policies and practices, sometimes it is not made entirely clear what the concept actually means.

Evidence-based policy is far more than just anecdotes or sound theoretical foundations. Possessing an evidence base means reliable research has been done on the practices underpinning the policy, and has repeatedly found aggregate, positive results. There is a burden of proof on proponents of particular policies to show that they are likely to achieve tangible beneficial educational outcomes.

Naturally, every school and every student is different. However, scientific research methodologies allow conclusions to be drawn about the probability that a particular policy or practice will be effective on average. Some education policies and practices obtain objectively better outcomes than others.

Reliable research

Not all evidence is equal in terms of reliability. The reliability of research is the likelihood that the results are accurate and that similar results can be expected if replicated. A simple outline of the evidence hierarchy, based on the NSW Government Centre for Education Statistics and Evaluation's hierarchy, is illustrated in Figure 1.

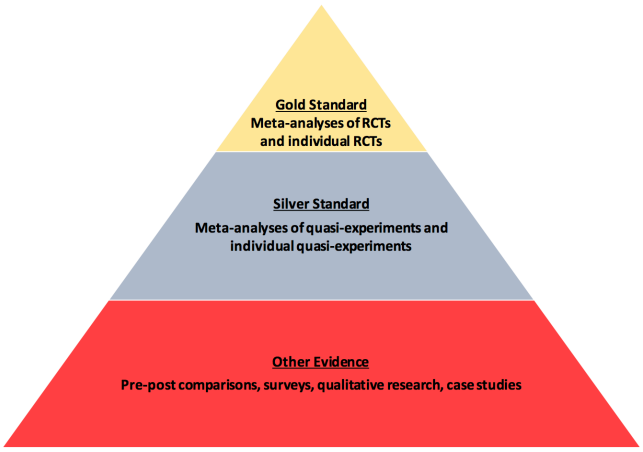
The most reliable research tends to be randomised control trials (RCTs), with a randomly-assigned treatment group and control group, and measured over a period of time. [9] In an educational context, the most rigorous RCTs involve a large sample size of students from a range of backgrounds and different schools, and control for student age—as programs typically affect age groups differently. The best evidence involves generating data that can be analysed, but this does not always mean numerical data.

Quasi-experiments are studies lacking—either entirely or to a significant degree—the random treatment and control groups. These studies still provide useful evidence but are less likely than RCTs to be free of bias and confounding variables, so are less reliable.[10]

Pre-post comparisons involve observations before and after the implementation of the policy or practice being studied. Since they do not include control groups, it is difficult to minimise the possibility other factors may be the cause of any observed changes.[11]

Surveys of teachers or students do not necessarily generate standardised responses or objective evidence.

Figure 1: Evidence hierarchy[8]



But if they are taken from a random sample and generate a high response rate, they can be particularly helpful in determining the experiences of the people involved in a policy or program.

Qualitative research, where data is not gathered (neither numerical data nor other types), can be helpful inasmuch as they establish the underlying theory behind particular practices or policies, and why they may or may not work. But unless they are supplemented by studies that involve actual data, it is not possible to determine if there are positive effects.[12]

Case studies of teaching practices in particular schools can also be helpful, as long as they are from a relevant context. There are obvious limitations of case studies: they apply to a particular school at a certain time and place, and it can be difficult to infer conclusions from one case that are applicable to other schools.

Meta-analyses, studies that combine data from previous studies and amalgamate the conclusions of existing quantitative research, are useful for summarising the overall evidence base on a particular topic.[13] They make it possible to combine existing studies without all stakeholders and policymakers having to read through every one of them individually and arbitrarily forming them together into a conclusion. An overall effect size of a particular policy or practice, based on the weighted conclusions across studies, can be determined. John Hattie's 2015 meta-analysis of other meta-analyses relating to 195 different factors affecting student achievement is comprehensive and well-known research.[14]

Nevertheless, meta-analyses still have significant limitations. Meta-analyses do not necessarily take into account the varying qualitative aspects of studies or the often significant differences between studies,[15] although this can be mitigated by having a weighted mean effect size with greater emphasis given to more rigorous studies.[16] In the case of Hattie's research, there are also criticisms of the complex methodology involved in synthesising the results of other meta-analyses, amongst other issues.[17] This means meta-analyses, such as Hattie's, are useful for summarising the findings of existing research but are by no means the only valid approach to finding the evidence base on a topic, and are certainly insufficient by themselves to come to a fully informed conclusion.

Meta-analyses are most robust when they focus on synthesising RCTs especially, since the underlying studies are more likely to be rigorous.[18] Systematic reviews of RCTs, where the qualitative aspects of existing studies are analysed, are also a valuable part of establishing an evidence base.

In the end, however, policymakers must come to conclusions based on the evidence that is actually available, not the evidence that would ideally be available. There may be some areas of education for which few or no RCTs, or meta-analyses, have been conducted, in which case it may be necessary to use the limited existing evidence to facilitate the most informed decisions possible. But it should be a priority to close any research 'gap' for particular education policies or practices, in order to build a reliable evidence base.

On top of the quality of the underlying evidence for a particular policy, policymakers should also consider the extent to which policies are able to be implemented on a large scale, and the level of cost-effectiveness. The standards of evidence used by the Queensland Department of Education and Training, for example, include scalability (the potential to implement) and investment (the creation of value).[19] This type of comprehensive approach is necessary if evidence is to translate into value-for-money investments.

Overseas experience

Overseas experiences can be valuable provided they are comparable to the Australian context. Given differences in culture, language, history, and academic environment between countries, it is important to acknowledge that, in many cases, overseas successes will not necessarily translate to success in an Australian school context. It is much easier to evaluate the effects of a teaching practice rather than a country-wide program, as there are fewer other factors to consider.

Nevertheless, if other countries outperform Australia in student outcomes, it is reasonable to compare the practices of those countries to Australia, and consider if there are any improvements Australia can make to its school system. This also requires considering correlations across many countries to see if relationships between particular factors and student results hold true.

The main indicators of international education performance are the Programme for International Student Assessment (PISA) and Trends in International Mathematics and Science Study (TIMMS). PISA assesses the reading, mathematical, and scientific literacy of 15 year-olds, while TIMMS assesses the maths and science problem-solving abilities of Year 4 and Year 8 students.

Australia's school policies can be compared to the international average or to those of the top-performing countries. The international average is affected by outliers, includes many less developed countries that are not comparable to Australia, and includes the worst performing countries — which Australia does not want to emulate. On the other hand, the top-performing countries may have particular policies that the worst-performing countries also have. This means the most balanced approach involves comparing Australia to both the international average and top-performing countries.

There are four countries (Singapore, Hong Kong, Japan, and Korea)[20] that in 2015 outperformed Australia on:

a) All three PISA tests — reading, science, and maths; and

b) The Year 4 and Year 8 maths and science TIMMS tests.

In addition, Finland, which didn't participate in the Year 8 TIMMS tests, also outperformed Australia on all three PISA tests and both Year 4 TIMMS tests.[21]

These five countries — Singapore, Hong Kong, Japan, Korea, and Finland — represent the top-performing

countries relative to Australia, insofar as they consistently outperform Australia on all of the main international standardised tests.

Obviously, the fact that one — or even all — of these five countries adopt a certain practice does not necessarily mean Australia should do the same. Nevertheless, if Australia is to boost its results, then it is important to consider the experiences of the top-performing countries Australia is attempting to match.

Linking funding to outcomes

There is a strong case for school autonomy,[22] but ideally all significant school investments should be evidence-based. It is also vital to link investments to desired outcomes, which in most cases will be student achievement. This is especially the case when taxpayer funding is involved, where the efficient use of money is paramount and should be demonstrable.

Part of the rationale for the significantly increased spending in the Gonski 2.0 plan is to raise the achievement of disadvantaged students by giving more funding to schools that need it most.[23] Under the Schooling Resource Standard (SRS) funding model, there are loadings that give extra money to schools with disadvantaged students. The loadings for disadvantage represent 25% of the total cost of the SRS.[24]

There are loadings for five different sources of disadvantage — one school-based (small and remote schools), and four student-based:[25]

- Low socioeconomic status (SES) students;
- Indigenous students;
- Students with disabilities; and
- Students with low English language proficiency.

While it is not entirely clear how the loadings should be spent to solve the specific problems they are intended to address, ultimately higher quality teaching helps all students and especially helps disadvantaged students.

Therefore, the extra funding flowing to schools with disadvantaged students under the Gonski 2.0 policy should be invested in practices that are demonstrably effective. Furthermore, the most cost-effective options should be implemented, since there are many possible approaches to boosting student outcomes, school resources are inevitably limited, and the effective use of taxpayer money is at stake.

Teacher professional development in Australia

Evidence-based policies and practices should also extend to professional development for teachers. Australian teachers are required to periodically attend professional learning activities as part of the teaching standards.[26] Therefore, it is imperative that this training is based on rigorous evidence and actually upskills teachers.

However, in Australia there are inconsistent standards for professional development providers, and hence they do not necessarily provide teachers with evidence-based practices.

New South Wales and the ACT are the only jurisdictions that require professional development providers to be accredited with requirements about evidence-based content.[27] While other states such as Victoria and South Australia require teachers to attend professional development that relates to one or more of the teaching standards,[28] this does not require the training providers to actually show the relevant content is evidence-based.

There is a concerning lack of consistent state-wide frameworks for ensuring professional development is based on evidence. Since teachers have to attend professional development, if what they are learning is not evidence-based, the learning will be ineffective — or even counter-productive — in boosting the quality of their teaching.

There is some evidence to suggest professional development activities in Australia are relatively ineffective in upskilling teachers. According to the OECD Teaching and Learning International Survey (TALIS) findings from 2013, Australian teachers were more likely than teachers in other countries on average to report their development had little or no meaningful impact on their capabilities.[29]

This issue is particularly concerning in Australia, because Australian teachers more consistently attend professional development compared to the OECD and some top-performing countries.

Figure 2 shows the extent of teacher professional development in Australia compared to the OECD average and high-achieving countries, according to TALIS 2013 data.

Australia has a significantly higher rate of teachers undertaking professional development compared to the OECD average and several high-achieving countries. In fact, Australia is the fourth-highest in the world on this measure of professional development.[31]

Figure 2: Teacher professional development in Australia and international comparisons (TALIS)[30]

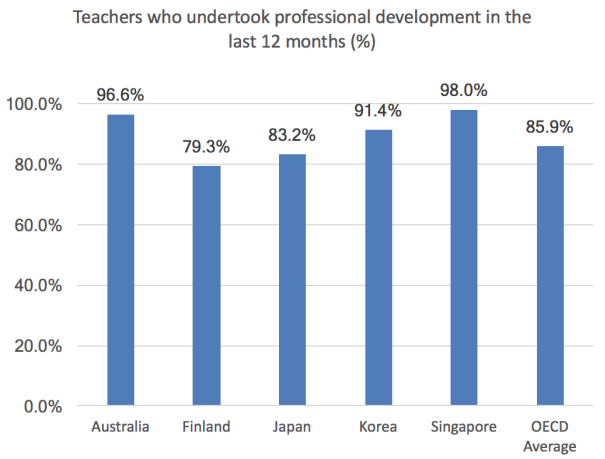


Table 1: Teacher professional development in Australia and international comparisons (TIMMS)[32]

Average percentage of maths and science teachers attending various subject-specific professional development			
		Maths	***Science***
Australia	Year 4	54	27
	Year 8	59	55
Finland	Year 4	11	6
	Year 8	N/A	N/A
Japan	Year 4	32	20
	Year 8	42	44
Korea	Year 4	33	40
	Year 8	44	55
Singapore	Year 4	61	56
	Year 8	61	66
Hong Kong	Year 4	65	41
	Year 8	53	56
International Average	Year 4	40	31
	Year 8	49	49

More recent TIMMS 2015 data relating to seven categories of teacher professional development, summarised in Table 1, leads to a similar conclusion.

On average, Australian maths teachers in Years 4 and 8 were more likely to have attended professional learning across the seven categories compared to teachers in Finland, Japan, Korea, and the international average, but less likely than Singapore teachers and Hong Kong Year 4 teachers.

In the area of science, there are less consistent results. Australian Year 8 teachers attended significantly more professional development on average compared to Japan and the international average, similar to Korea and Hong Kong, and well below Singapore. Year 4 teachers in Australia attended significantly more learning than those in Finland or Japan, but less than Korea, Singapore, Hong Kong, and the international average.

Overall, however, it appears Australian school teachers attend more than enough professional development activities, relative to the OECD and the top-performing countries. Therefore, the policy focus should be on improving and driving better evidence-based professional development, through having higher standards for the training providers — which would not need to cost schools any further money.

Three evidence-based school investments

Early literacy and numeracy intervention

Australia's literacy and numeracy results in international standardised tests significantly declined in the years leading up to 2015. This is part of the rationale for having the Gonski 2.0 review.

Australia's absolute performance in all three PISA tests have recently worsened: [33]

- Science: between 2006 and 2015, average performance declined by 17 points;
- Mathematics: between 2003 and 2015, average performance declined by 30 points; and
- Reading: between 2009 and 2015, average performance declined by 12 points.

Australia's absolute performance in all four TIMMS tests have either declined or seen no significant improvement in recent years: [34]

- Year 4 Mathematics: between 1995 and 2015, average performance improved by 22 points, but between 2007 and 2015 there has been virtually no improvement;
- Year 8 Mathematics: between 1995 and 2015, average performance declined by 4 points;
- Year 4 Science: between 1995 and 2015, average performance improved by 3 points; and
- Year 8 Science: between 1995 and 2015, average performance declined by 2 points, but declined by 15 points between 2003 and 2015.

Australia's performance on the PISA and TIMMS tests relative to other countries has also recently declined.[35]

The most direct way of addressing this issue is to consider which teaching practices are most effective in terms of boosting student literacy and numeracy. Consulting the recent literature on the subject, there are several strong conclusions.

Successfully intervening to help students who are underperforming in literacy and numeracy involves two general aspects:

1. Identify students who are underperforming and intervene to help them.
2. Improve literacy and numeracy teaching to reduce the number of students who underperform in the first place.

In regards to the first aspect, the evidence base indicates intervention to help underachieving students in literacy and numeracy is far more effective in early primary years than in later schooling.[36] Early literacy and numeracy also have significant effects on student achievement in science in later years.[37] Underperforming students are able to be brought up to the expected level through intervention much more quickly in primary school than in secondary school.

Therefore, it is imperative underperforming students are identified as early as possible so as to facilitate timely intervention. This approach was endorsed by the first Gonski Report.[38]

The federal government's proposed early literacy and numeracy check[39] is a sensible step towards helping underperforming students catch up with their peers as soon as possible. There is a significant amount of evidence to support a phonics check in particular.[40] This initiative should be implemented, taking into account the experience of similar, best practice checks from around the world.

Intervention for literacy and numeracy also appears to be more effective when done with specialist support outside the classroom for underperforming students, rather than being limited to instruction within the classroom.[41]

Regarding the second aspect, best practice in teaching literacy and numeracy is not necessarily common practice.

In particular with respect to the vital skill of reading, explicit phonics instruction within a comprehensive literacy program is far more effective than a whole-language approach, but this is not necessarily reflected in common teaching practices in Australia.

Six studies — including three meta-analyses — from the past 10 years have concluded phonics is an effective means for teaching students to read.[43] For example, John Hattie's meta-analysis indicates phonics significantly boosts student achievement: the 0.52 effect size for phonics instruction is well above the average effect size of 0.4, in contrast to the below-average — barely positive — 0.06 effect size for whole-language techniques.[44]

Additionally, eight other recent studies provide evidence to suggest phonics instruction is particularly effective for boosting the academic performance of disadvantaged students, including students with English as a second language, students with reading difficulties, and students with disabilities.[45] Given one of the main aims of the Gonski 2.0 policy is to improve outcomes for disadvantaged students, a greater focus on phonics is desirable.

Furthermore, three rigorous reviews from government bodies in different countries have recommended the teaching of phonics:

- The 2005 National Inquiry into the Teaching of Literacy in Australia;[46]
- The 2006 Independent Review of the Teaching of Early Reading in England;[47] and
- The 2000 National Reading Panel in the US.[48]

It is quite clear how to best teach reading, with phonics being an essential part of the required measures. Therefore, it is essential to instill the ability to effectively teach phonics into primary school teachers. Phonics instruction by itself is insufficient for effective teaching of reading — for example, a rigorous curriculum which facilitates reading comprehension in the later years of primary school is also necessary — but it is an essential component.

However, according to a recent Australian systematic literature review, three other recent Australian studies, and a recent book, many primary school teachers have

Box 1: Phonics vs Whole-Language[42]

There are broadly two main schools of thought regarding how to teach reading, although they are not necessarily mutually exclusive:

1. *Phonics-based instruction*. Instruction based on linking sounds and letters, beginning with regular connections and gradually progressing to less regular connections. This involves learning and using the relationships between sounds and letter-symbols to sound out (decode) written words.
2. *Whole-language instruction*. Instruction with a greater focus on immersing children in text so as to allow them to 'pick it up' by looking at whole words without generally breaking them down into connections. This often involves students being encouraged to guess unfamiliar words by looking at context. 'Balanced Literacy' programs tend to incorporate a whole-language approach.

In simple terms, there are also two types of phonics instruction:

1. *Systematic synthetic phonics*. Involves learning the associations between letters and their sounds in a clearly defined, incremental sequence, building up phonic skills from their smallest unit.
2. *Analytic phonics*. Involves analysing (breaking down) whole words to their parts, with students receiving the required information from word structure, based on similar sounding words.

The evidence base points to two conclusions about how best to teach reading:

1. Phonics instruction is more effective than whole-language instruction.
2. Systematic synthetic phonics is more effective than analytic phonics.

Phonics instruction by itself is insufficient for teaching reading; it is a necessary component of effective reading instruction.

not adequately learnt phonics teaching during their education degrees and do not possess sufficient language knowledge to effectively teach phonics.[49] Whole-language approaches are still common in Australia and it appears phonics is not consistently practiced.[50]

The strong evidence-base for teaching phonics together with the apparent lack of consistent implementation of phonics is a compelling argument for primary schools to help teachers better teach phonics. The most direct way of doing this is by providing primary school teachers with professional development specifically aimed towards phonics.

As discussed earlier, Australian schools already typically invest significant resources in professional development for teachers, so investing in professional development with a focus on reading and phonics would not necessarily cost much more if money was simply reallocated from less-effective professional learning activities.

It is important to emphasise that a focus on improving phonics instruction does not mean an over-emphasis on phonics at the expense of other areas of the curriculum. While a child's decoding ability is a strong predictor on their early reading achievement—which allows them to read more and develop their vocabulary—reading comprehension in the later years of school is also dependent on general knowledge.[51]

In conclusion, there are two evidence-based investments schools can make with a strong potential to boost their literacy and numeracy results:

1. Targeted spending on early literacy and numeracy support staff and evidence-based programs.
2. Investing in professional development for primary school teachers on the specific topic of how to best teach reading, including training on teaching phonics.

These initiatives would also complement the early years literacy and numeracy check: by attending relevant professional development, primary school teachers would be equipped with the skills necessary to teach reading effectively and intervene to help underperforming students, supported by specialist staff and programs.

Give teachers fewer classes and more time outside the classroom

Australian teachers at all levels of schooling spend significantly more time teaching on a school day compared to the OECD average and top-performing countries, as illustrated in Figure 3.

These OECD 2015 figures, from countries for which the relevant data is available, suggest Australia could consider giving teachers more preparation time and fewer classes.

Australian teachers in upper secondary education, for example, teach on average over one hour more per day compared to teachers in top-performing countries Korea, Japan, and Finland.

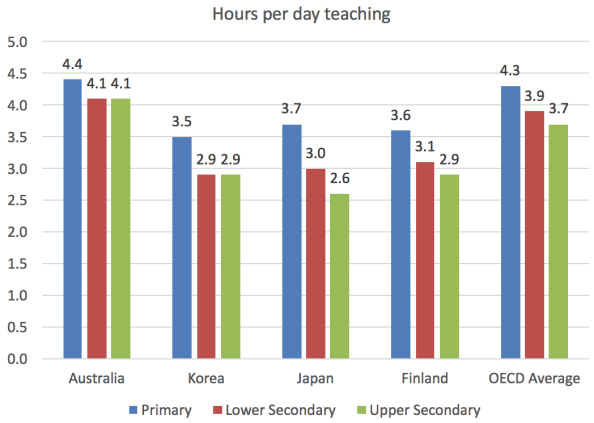
The OECD Director for Education and Skills, Andreas Schleicher, recently suggested Australia should consider giving teachers less class time so they can focus more on high-quality teaching.[53]

Teachers who spend more time teaching have less time to complete other work-related activities, all else being equal. If teachers are given fewer classes, they potentially have more time outside the classroom to further prepare, review, and refine lessons, as well as to collaborate more with other teachers. Quality teaching is broader than just teacher practices during lessons. Effective lessons require extensive work outside the classroom before and after delivering the lesson.

Teacher lesson planning and preparation time is positively associated with student results.[54] This is unsurprising, since lesson structure and content will generally be superior if prepared in advance, rather than hurriedly arranged immediately before or even during a lesson. In addition, according to a systematic review of relevant studies, teacher reflection and review of lessons tends to lead to superior future lessons, with teachers enhancing their effective practices and discontinuing their ineffective practices.[55]

Teacher collaboration also appears to have a positive effect on both teaching quality and student outcomes, according to the results of seven recent studies.[56] Examples include teachers observing each other's lessons, sharing classroom resources, conducting research together, and discussing lesson plans. A specific approach is micro-teaching, which involves teachers reviewing video recordings of their lessons and receiving feedback from their peers, and has been found to be effective in improving the quality of teaching by a number of recent studies.[57] Hattie's meta-analysis

Figure 3: Teacher class time in Australia with international comparisons[52]



concluded micro-teaching is among the most effective of all teacher practices with an effect size of 0.88.[58]

Teacher mentoring and coaching can also help reduce teacher stress and improve learning.[59] This could be facilitated by giving teachers fewer classes, since more experienced teachers would receive additional time to help less experienced ones.

There is some evidence to suggest teacher collaboration is an untapped potential in schools. Surveys of new teachers in Australia indicate they do not receive sufficient support from more senior colleagues[60] and up to 50% of new teachers leave the profession within the first five years.[61] It has been reported there is a lack of collaboration and feedback provided to new teachers on their lessons.[62] First-year teachers have also expressed concern at an inadequate amount of time to prepare and review lessons.[63] This indicates having fewer teaching hours per day could boost teacher efficacy for new teachers in particular.

Additional time outside the classroom would not necessarily be beneficial for teaching and learning if the extra hours are used ineffectively. It is important teachers are not burdened with extra administrative work in lieu of more teaching hours. For example, expecting teachers to prepare lesson plans using templates that are not evidence-based would be time-consuming and ineffective.

One potential downside of reducing teacher class time would be the corresponding need to increase the number of teachers. If all teachers are teaching less, then more teachers may be necessary, which could result in teacher quality dilution and substantial extra cost.

There are several possible approaches to ameliorating this concern and minimising the extra costs of more teacher time outside the classroom. Teaching hours could be made more proportional to teacher experience — in other words, give new teachers fewer classes and gradually increase teaching time as they become more experienced. A suggestion by Schleicher is to increase class sizes to offset the need for more teachers.[64] Two other possible options are increasing teacher efficiency, and reducing teacher activities outside class that do not directly improve teaching, such as ineffective professional development and unproductive staff meetings.[65]

In summary, it appears a potentially cost-effective way of improving student achievement is to give teachers more time outside the classroom. This would naturally be accompanied with the expectation that teachers use the extra time to collaborate, plan future lessons, review previous lessons, and do research on evidence-based practices. If implemented effectively, teaching quality would improve, leading to a rise in student results.

Classroom management professional development for teachers

The classroom management of Australian teachers appears to be less effective compared to the international average and high-performing countries.

TIMMS data from 2015, based on responses by school principals, indicate Australia has a relatively high number of school discipline problems, as shown in Table 2.

Australian Year 4 students are more likely to display discipline problems compared to all five high-performing countries, although marginally less likely compared to the international average. The same is true of Australian Year 8 students, and in fact the majority of Australian Year 8 students cause at least minor discipline issues, although they are significantly less likely to display moderate to severe discipline issues compared to Korea, Japan, and the international average. But overall, Australian students appear more likely to cause discipline problems than the top-achieving countries.

Table 2: School discipline problems in Australia and international comparisons (TIMMS)[66]

School Discipline Problems (% of students with discipline issues)						
	Year 4			Year 8		
	Hardly any	Minor	Moderate to severe	Hardly any	Minor	Moderate to severe
Australia	64	30	6	48	51	1
Singapore	72	28	0	74	26	0
Hong Kong	71	29	0	66	33	1
Korea	81	14	5	55	38	7
Japan	74	20	6	54	37	9
Finland	68	31	1	N/A	N/A	N/A
International Average	60	31	10	43	45	11

Table 3: Classroom misbehaviour in Australia and international comparisons (PISA)[67]

Classroom Misbehaviour (% of students who report the following issues)					
	Students don't listen to what the teacher says	***There is noise and disorder***	***The teacher waits a long time for students to quiet down***	***Students cannot work well***	***Students don't start working for a long time after the lesson begins***
Australia	32	33	29	22	26
Hong Kong	40	43	34	24	28
Singapore	15	14	13	13	14
Finland	9	11	8	13	9
OECD average	24	24	19	14	17

The PISA 2015 data on classroom behaviour reaches a similar conclusion. Table 3 shows Australian classrooms have more issues with misbehaviour compared to the OECD average and several high-performing countries, based on the responses of 15 year-old students.

For all five types of misbehaviour, Australian 15 year-old students were significantly more likely to report issues than the OECD average, Singapore, and Finland, but less likely than Hong Kong.

Australian students from low SES backgrounds reported much higher rates of classroom misbehaviour than average.[68] Overall, classroom misbehaviour was negatively correlated with student SES.

One limitation of both the PISA and TIMMS data is that they are based on self-reporting from principals and students in the individual countries. That is, they do not use standardised observations but rather take a survey of personal experiences. This means differing expectations of principals and students across countries may impact the comparability of the results. For example, students in some countries may have higher expectations of classroom behaviour than in others, and so could report higher levels of noise and disorder while in reality they are no worse, or vice versa.

Nevertheless, the PISA and TIMMS data are the best available international comparisons of classroom behaviour, and on balance they strongly indicate Australian schools are far more likely to have student misbehaviour compared to top-performing countries.

Furthermore, irrespective of international comparisons, misbehaviour has a strong negative impact. There is a large amount of evidence indicating poor student behaviour and school discipline has a considerable negative effect on student achievement, according to a recent systematic review of the literature.[69]

Students also learn significantly more content in ordered classrooms where the teacher is perceived to be in control. A recent meta-analysis and RCT from the US confirm teachers who utilise effective classroom management techniques can boost their students' results.[70] According to Hattie's meta-analysis, while the typical effect size of 195 factors affecting student achievement is 0.4, the effect sizes relating to teacher management of the classroom are relatively high: classroom behaviour (0.63), classroom cohesion (0.53), teacher-student relationships (0.52), and classroom management (0.52).[71]

Recent studies by Macquarie University researchers have found, on an aggregate national level, school discipline is a very important factor affecting achievement in PISA tests.[72] In fact, they indicate school discipline explains significantly more of the variation in PISA scores (88%) than the level of school funding (12%).[73]

As a result, one possible way for Australia to improve its literacy and numeracy results would be to improve teacher classroom management.

There is evidence to suggest many new Australian teachers are still unprepared to handle classroom misbehaviour following completion of their teaching degrees.[74] New teachers who have completed a subject in their degree specifically on classroom management are more confident,[75] although not all teaching degrees in Australia have a compulsory classroom management subject.[76] Four studies and two reports published in recent years have indicated there is a lack of evidence-based classroom management practices taught in Australian teacher education degrees and insufficient emphasis placed on preparing teacher education students to manage behavioural issues.[77] Furthermore, surveys of teachers indicate classroom management is a key source of stress and a major reason for why some choose to leave the profession.[78]

Given the importance of effective classroom management and the widespread issues currently experienced by Australian teachers, professional development on classroom management would be highly beneficial for teachers. Effective professional development could help make up for the lack of evidence-based classroom management practices learnt in initial teacher education.

In general, teachers' professional development can have positive impacts on their students' outcomes.[79] Four studies published in the past five years have indicated classroom management professional development in particular can help to improve both primary and secondary student behaviour.[80]

Therefore, investing in teachers' classroom management skills through professional development would be a worthwhile step to improve student achievement. Since the problem of student misbehaviour is considerably worse among students from lower SES backgrounds, improving the student behaviour management of teachers could help disadvantaged students in particular.

However, it would be necessary to ensure the classroom management professional development is evidence-based; otherwise, it could be ineffectual or even counterproductive.

This proposal would not necessarily cost substantially more money if school resources were reallocated from less important professional development.

A viable and worthwhile approach to improving Australia's education results is to better support teachers in improving classroom management, given Australian teachers appear to be ill-equipped to implement effective classroom management and the prevalence of school discipline issues in Australia relative to top-performing countries. Investing in more teacher professional development specifically relating to evidence-based classroom management techniques would be a cost-effective way of improving classroom behaviour and hence student achievement.

Box 2: Evidence-based classroom management practices

The most effective, evidence-based classroom management practices should be included in professional development, as a response to the lack of comprehensive classroom management education in teaching degrees.

Some examples of evidence-based practices are presented in a 2014 paper by O'Neill and Stephenson, which reviewed common classroom management practices taught in teacher education degrees, and found the following 18 classroom management techniques are effective:[81]

1. Token economy.
2. Forming and establishing classroom rules.
3. Praise, encouragement, positive feedback.
4. Individual behaviour contracts.
5. Altering classroom structure/environment.
6. Student self-monitoring and evaluation systems.
7. Group contingency (whole class incentives).
8. Time-out from positive reinforcement.
9. Teacher physical proximity/mobility.
10. Devising and teaching class routines.
11. Tactical/planned ignoring.
12. Communicating clear behavioural/academic expectations.
13. Reprimands, correction statements, desists.
14. Response cost.
15. Diagnosing underlying function.
16. Creating and using behaviour intervention plans.
17. Pre-corrections, cues, prompts (antecedent).
18. Social skills instruction.

Two common school investments requiring further evidence

Smaller class sizes

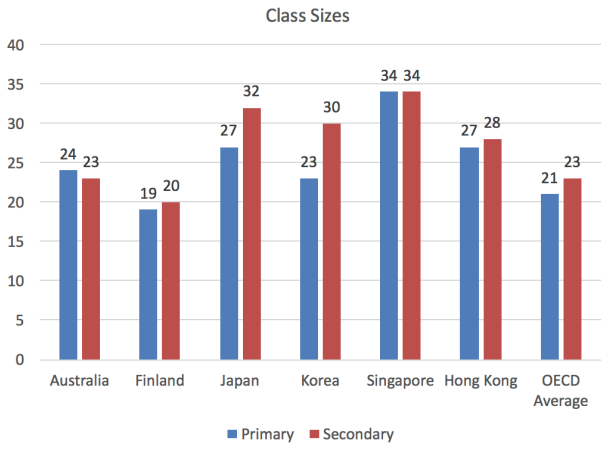
It has often been suggested that smaller classes boost student results and Australia should reduce its class sizes.[82] The instinct behind this is understandable: people feel that smaller classes could enable teachers to better cater for the needs of individual students and allow for more student participation. Class size reduction has been a policy pursued by many governments around the world in an attempt to improve student achievement — but largely without success.[83]

2015 class sizes in Australia with international comparisons are shown in Figure 4.

Australia's average primary class size is above the OECD average, Korea, and Finland, but below Japan, Hong Kong, and Singapore. The Australian average secondary class size is higher than Finland, the same as the OECD average, and significantly below all other top-performing countries. It can be inferred from this that lower class sizes are not necessary for Australia to improve its results. There is no clear link between class size and academic achievement on an aggregate country-level.

According to the recent literature, reducing class sizes appears to have only small — and inconsistent — positive effects on student achievement. In considering 22 studies from the past five years on the effects of smaller classes, there is conflicting evidence:

Figure 4: Class sizes in Australia with international comparisons[84]



- 10 studies found little or no positive impacts of reducing class sizes on student achievement, in relation to:
  - Australian NAPLAN results;[85]
  - 14 European countries (2 studies);[86]
  - 8 European countries;[87]
  - Greece;[88]

  - Several US states;[89]
  - US state of Georgia;[90]
  - US state of Minnesota;[91]
  - US state of Florida;[92] and
  - Aggregating the existing studies on class sizes in Hattie's meta-analysis, which gave class sizes a relatively small effect of 0.21, well below the average effect size of 0.4, and ranked 148 out of 195 factors affecting student achievement.[93]

- 8 studies came to mixed conclusions on the impacts of smaller class sizes, relating to:
  - Cyprus — finding evidence of a significant positive effect in Year 8, but no significant relationship in Year 4;[94]
  - France — which found small yet significant positive effects in Years 6 and 7, but no positive effects in Years 8 and 9;[95]
  - US state of Tennessee — finding positive effects for more experienced teachers, with no positive effects for new teachers, and smallest positive effects for the lowest performing students;[96]
  - Japan — finding positive effects, especially in wealthier areas, but that this did not help to close the achievement gap between low-performing and high-performing students;[97]
  - Evidence from the US and worldwide — finding no positive effects in the US but stating the positive effects internationally are not negligible; [98]
  - International evidence — inferring smaller classes help especially in early years of schooling, and the most positive effects are for disadvantaged students, but concluding that there are more cost-effective ways of improving student performance than through class size reduction;[99]
  - Developing countries — a meta-analysis found a significant positive impact, although it qualified this by stating that some studies of effects of class size reduction in developing countries contradicted this conclusion;[100] and
  - Quality of US teachers — finding a temporary short-term decline in teacher quality as a result of class size reduction, but concluding that this reduction in teacher quality by itself could not explain why smaller classes tend not to have significant positive effects on student achievement.[101]

- 4 studies, which did not examine how smaller classes affect student academic achievement, found positive effects on student confidence, belonging, cohesion, participation, and motivation, based on a small number of case studies.[102]

The OECD in 2012 concluded:

> "Reducing class size is not, on its own, a sufficient policy lever to improve the performance of education systems, and is a less efficient measure than increasing the quality of teaching…In a period of economic crisis and tightened public budgets, while analyses of OECD data do not establish a significant relationship between spending per student and average learning outcomes across countries, PISA data shows that high-performing education systems are commonly prioritising the quality of teachers over class size."[103]

This conclusion has also been restated recently by the OECD Director for Education and Skills, Andreas Schleicher, who suggested Australia consider increasing its class sizes to improve results.[104]

On the balance of the available evidence and the recent literature on the subject, reducing class sizes is not a cost-effective way of boosting student achievement.

There have been a range of explanations postulated as to why smaller class sizes do not improve student results, including the risk of lowering the quality of teaching due to the need for more teachers,[105] and a possible tendency of teachers to not change how they teach when moving from larger to smaller classes.[106]

In any case, much more evidence would be required to justify significant spending to achieve smaller classes, given the expensive nature of reducing class sizes, the potential to reduce teacher quality, and the only minor positive effects on student achievement.

Technology

There has been a growing call for Australia to invest more in classroom technology and 'digital literacy' — such as teaching coding — in order to boost students' achievement and prepare them for the 21st century.[107] However, Australia already tends to invest significantly more in education technology relative to the rest of the world.

A comparison of Australian school students' use of computers at school and other OECD countries, based on 2012 PISA data, is shown in Table 4.

Australian students use computers at school significantly more than students in all five top-performing countries. In fact, Australia has the second-highest percentage in the OECD for countries with the available data, behind only the Netherlands' 94.0%. Computers for educational purposes in school per student in Australia is more than double that of all five top-performing countries and the OECD average for countries with the comparable data.

This finding is corroborated by the more recent TIMMS 2015 data on student access to computers in lessons in Australia and internationally, outlined in Table 5.

Australian students are on average far more likely to have access to computers for use in lessons than the international average and several high-performing

Table 4: Students use of computers at school in Australia with international comparisons[108]

	% of students using computers at school	Computers for educational purposes per student in the school
Australia	93.7	1.53
Singapore	69.9	0.67
Hong Kong	83.8	0.73
Korea	41.9	0.40
Japan	59.2	0.56
Finland	89.0	0.46
OECD average	71.8	0.68

Table 5: Student access to computers in lessons in Australia with international comparisons[109]

% of students with computers available to use in lessons				
	Year 4 maths	**Year 8 maths**	**Year 4 science**	**Year 8 science**
Australia	60	62	63	66
Singapore	37	35	49	52
Hong Kong	45	21	47	21
Korea	14	39	22	50
Japan	50	43	65	55
Finland	56	N/A	64	N/A
International Average	37	32	46	42

countries. For both maths and science in Years 4 and 8, a significantly higher percentage of Australian students have access to computers in class than students in Singapore, Hong Kong, Korea, and compared to the international average. This is also the case with respect to Japan, with the exception of Year 4 science. Finland's Year 4 students have similar in-lesson access to computers compared to Australia.

The TIMMS 2015 data also shows the extent to which teachers in different countries ask their students to use computers in lessons.[110] This is illustrated in Figures 5–8.

Based on this TIMMS data, Australian teachers are far more likely to ask their students to use computers in lessons compared to other countries. For all purposes for Years 4 and 8 science and maths, Australian teachers

Figure 5: Year 4 maths students' use of computers

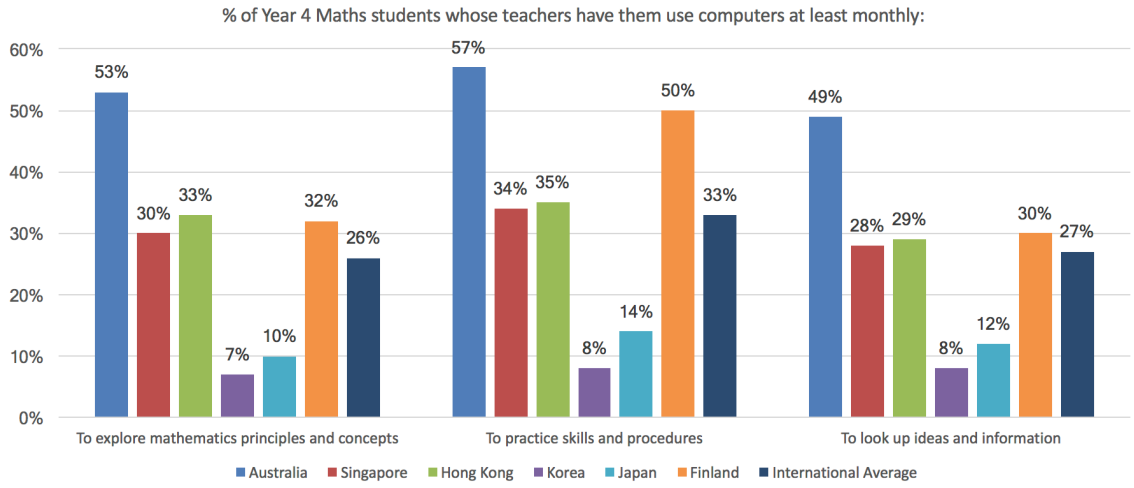


Figure 6: Year 8 maths students' use of computers

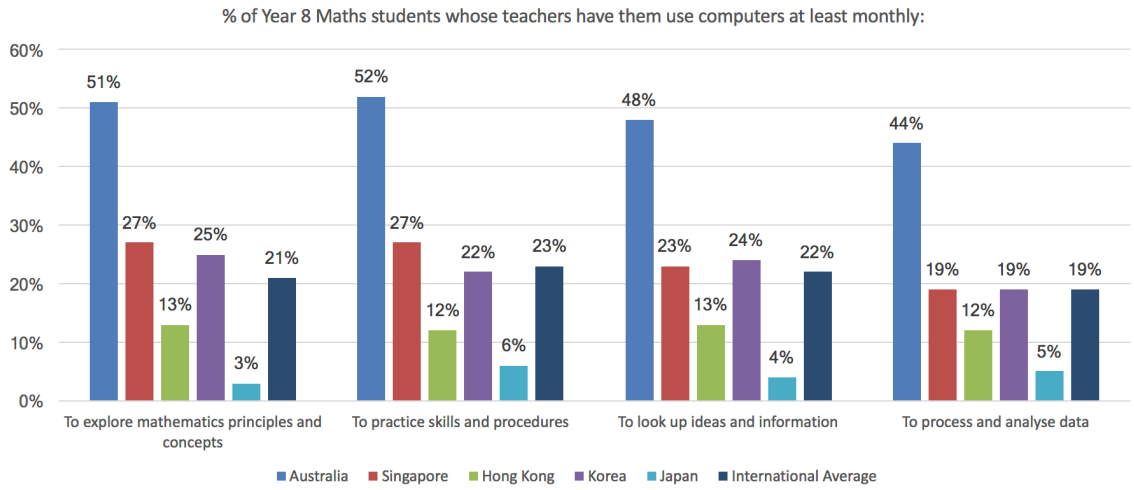


Figure 7: Year 4 science student's use of computers

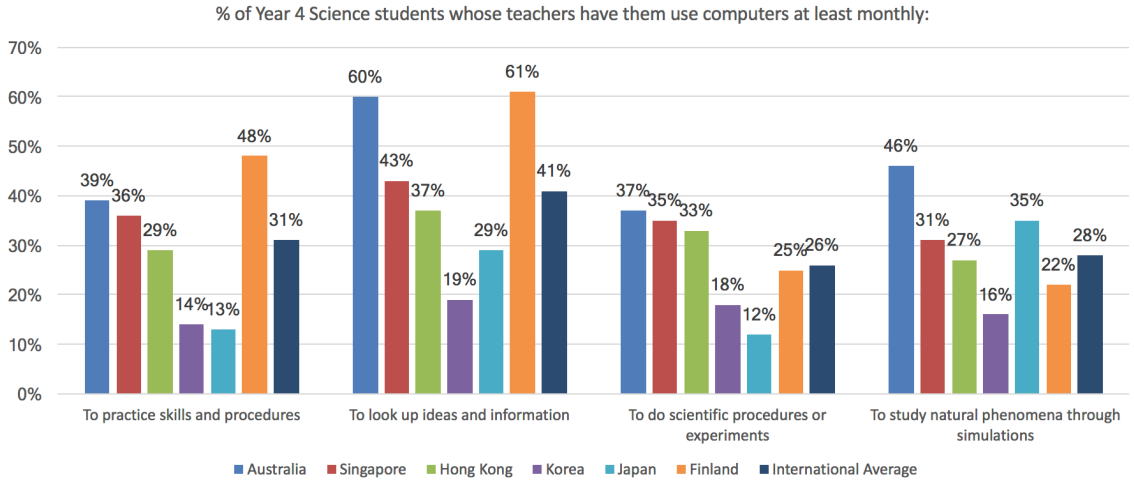
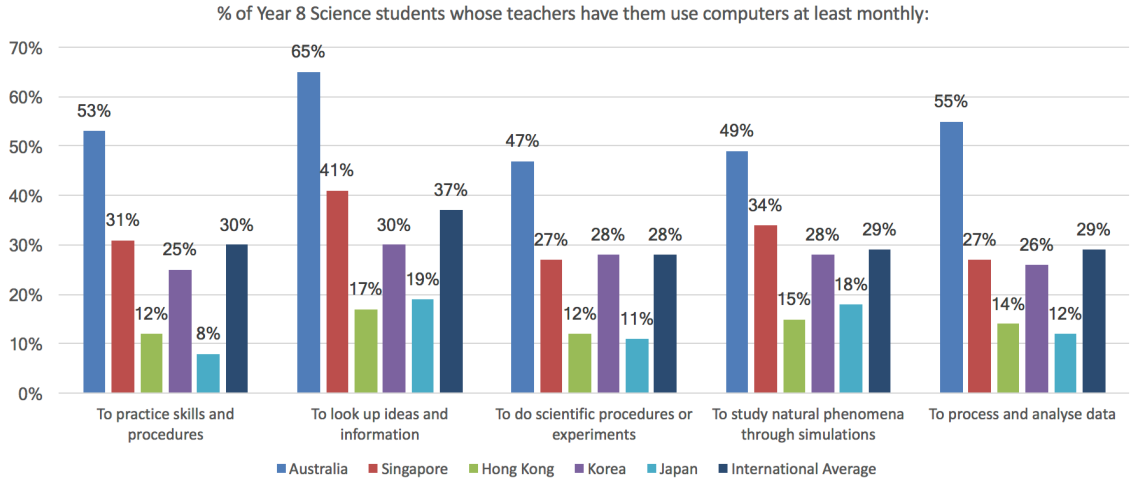


Figure 8: Year 8 science students' use of computers.



make their students use computers significantly more frequently compared to all high-performing countries and the international average, with just two exceptions relating to Finland in Year 4 science.

From this data, it appears classroom technology by itself is insufficient to raise educational performance, and certainly Australian schools investing even more in educational technology would not be justified on this basis.

Recent studies provide conflicting evidence about the impact of educational technology on student achievement, with findings ranging from no to significant positive effects, often depending on the uses and context:

- Several recent studies have shown no effect or negative effects.
    - A study based on PISA 2012 maths results data from Australia, Germany, the Netherlands, Norway, and Singapore found significant negatives effects in the Netherlands and Germany, and no significant effects in the other three countries including Australia.[111]
    - A study based on TIMMS data from 2003 to 2011 across 39 countries found negative effects of frequent school computer use on student achievement.[112]
    - A study based on PISA maths and science results from 2000 to 2012 across 43 countries found a positive correlation between technology use and student achievement; but when students' SES was held constant the effects of technology were actually negative.[113]
    - A study based on PISA 2012 data across 39 countries found frequency of technology use in schools correlates negatively with maths, reading, and science scores in the vast majority of countries, but concluding the quality of educational technology use is more important than the quantity of use.[114]
    - An RCT found substituting laptops for textbooks in Honduras had no effect on literacy or numeracy.[115]
    - A study of the One Laptop per Child program in Peru found no effect on literacy or numeracy results.[116]
- Several other recent studies have shown significant positive effects.
    - A study based on PISA 2012, TIMMS 2011, and PIRLS 2011 data across 43 countries found: [117]
        - Significant positive effects of national use of ICT on country-wide Year 4 and Year 8 students' achievement;
        - Significant positive effects of ICT usage on individual Year 4 students' achievement; but
        - Significant negative effects of ICT usage on individual Year 8 students' achievement (as opposed to a country-wide level).
    - A meta-analysis examining studies from the past 40 years found overall technology has a significant (low to moderate) positive impact on student learning.[118]
    - A meta-analysis considering the impact of technology on the learning effectiveness of elementary students found overall medium positive effects, which varied significantly depending on the subject.[119]
    - A research synthesis and meta-analysis of one-to-one laptop programs in schools found significant positive effect sizes in English, writing, mathematics, and science.[120]
    - A meta-analysis synthesis of other meta-analyses between 1985 and 2015 considering the benefits of technology-enhanced mathematics instruction found a moderate positive effect.[121]
- Hattie's meta-analysis effect sizes varied depending on the particular uses of technology.[122]
    - In general, computer-assisted instruction (CAI) had an effect size of 0.45, above the average of 0.40. But for high-school students (0.30) the effect size was below the average.
    - CAI in both mathematics (0.30) and reading/literacy (0.26) were below the average.
    - CAI in science (0.23) was also below the average, but CAI in writing (0.42) was just above, while CAI in other subjects (0.55) was well above.
    - CAI specifically for learning needs students (0.57) appears to be relatively effective, as are interactive video methods (0.54).
    - CAI in small groups (0.21), web-based learning (0.18), and CAI in distance education (0.01) all appear to be relatively ineffective.

A limitation of most of the existing research on the subject is the serious difficulty in identifying the direct causal impact of ICT on student results,[123] while a disproportionate amount of the relevant research to date is based on small case studies from a small number of schools.[124] Nevertheless, it appears given the right circumstances and uses some level of technology can be beneficial to student learning.

The OECD's comprehensive report on technology and schools in 2015 concluded:

> "Resources invested in ICT for education are not linked to improved student achievement, in reading, mathematics or science.
>
> In countries where it is less common for students to use the Internet at school for schoolwork, students' performance in reading improved more rapidly than in countries where such use is more common, on average.
>
> Overall, the relationship between computer use at school and performance is graphically illustrated by a hill shape, which suggests that limited use of computers at school may be better than no use at all, but levels of computer use above the current OECD average are associated with significantly poorer results."[125]

There is simply insufficient evidence to suggest technology is a cost-effective way for a country to boost student literacy and numeracy, due to the conflicting findings in the recent literature and the lack of a clear link between top-performing countries and investment in classroom technology.

While there may be qualitative benefits of exposing students to more technology in schools, these are much more difficult to measure than—and ultimately not as important as—literacy and numeracy skills.

Another reason investing in technology can be problematic is that hardware can quickly become obsolete, as can teacher and student software.[126]

Given the ongoing high cost of investing in technology, the fact Australia already has a far higher use of classroom technology compared to the rest of the world, and the uncertainty over the extent of the positive effects, much further evidence would be required to justify additional significant school investments in this area.

Box 3: Case study—The Digital Education Revolution program

Between 2008 and 2013, the Rudd and Gillard governments introduced and implemented the Digital Education Revolution, a program whereby the federal government funded laptops for all school students from Year 9 to Year 12. Almost 1 million computers were issued as part of this policy, which was discontinued by the Gillard government in 2013.[127]

The cost of the program for the Commonwealth ended up being much higher than originally anticipated—rising from $1.2 billion to over $2 billion.[128]

There were extensive criticisms of the program, including the cost blow-out, the requirement for states and territories to co-contribute, the lack of financial support for the ongoing costs of the program beyond the initial hardware provision, delays in implementation, the laptops being too slow, and a lack of training for teachers to learn how best to use the computers to enhance student learning.[129]

An independent mid-program review of the Digital Education Revolution found significantly more work had to be done to improve teacher capability to positively utilise technology in schools, and that computers arrived before schools had adequate knowledge of how to use them.[130] Nevertheless, the review did find the program had been successful in meeting its main goals of being a catalyst for positive change that establishes the foundations for improved use of ICT in education.[131]

The surprising feature of both the program and its independent review was the lack of any link to student academic outcomes. It was simply assumed, without evidence, that computers would improve student achievement.[132] There was no evaluation of the program's impact on NAPLAN, PISA, or TIMMS results. The stated purpose of the program was not actually to improve student achievement in literacy and numeracy, but rather to change the way secondary teaching and learning occurs, and to provide students with access to technology for 'contemporary learning'. [133]

This case study illustrates many of the difficulties with investments in education technology. The specified aims tend to be vague and not linked to tangible student outcomes. There is also a potential for significant cost blow-outs and implementation difficulties, especially when the teachers themselves are not adequately trained to utilise the new technology.

Conclusions

More school funding can lead to improved student results if — and only if — it is spent effectively.

When considering the evidence regarding the best school programs and policies, there are several striking inconsistencies between these and what actually occurs in the Australian school system.

There appears to be a lack of evidence-based reading instruction in schools, and taught to teachers in their education degrees. This also applies to teacher professional development, as Australian teachers attend professional learning relatively frequently but the providers are generally not required to base their teaching practices on evidence.

There is evidence to suggest teachers — especially new teachers — do not have sufficient time outside the classroom to plan and improve lessons. Furthermore, classroom behaviour data in Australia is concerning and it seems teachers are not taught evidence-based classroom management practices sufficiently at university.

Given these current issues with Australia's school system, there are three evidence-based school investments that schools should consider to boost student achievement in general and in particular for disadvantaged students:

1. Early literacy and numeracy, specifically in specialist support staff and evidence-based programs, and professional development for primary school teachers on how to teach reading and phonics.
2. Give teachers fewer classes and more time outside the classroom.
3. Classroom management professional development for teachers.

There are also two common school investments in Australia for which there is insufficient evidence to justify significant further spending:

1. Smaller class sizes, which would be expensive, have the potential to reduce teacher quality, and have only minor positive effects on student achievement. Relative to the top-performing countries in the world, Australian class sizes are not especially large, so reducing class size is not a pressing investment.
2. Technology, where the extent of any positive effects is uncertain, already has substantial ongoing costs. Australia currently invests significantly more in school technology relative to the rest of the world, but this by itself has not helped to improve literacy and numeracy.

Faced with the problem of declining literacy and numeracy levels, it can no longer be acceptable to base education policies and practices merely on intuition, or to maintain naive expectations about the positive impact of more school funding.

Evidence-based education investments are necessary if Australia is to have a world-leading school system in which all students can flourish.

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About the Author

Blaise Joseph

Blaise is an education policy analyst and a former teacher. He specialises in policy relating to education funding in Australia and has recently been working with Research Fellow Jennifer Buckingham on school funding models.

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