MATHS PATHWAY

2019 IMPACT REPORT

Reimagining the maths classroom

Do not confine your children to your own learning, for they were born in another time.

CHINESE PROVERB

Contents

Driven by purpose

Thanks for taking the time to read our 2019 Impact Report. Here, we offer data and stories about our impact, and welcome those who share our vision into the Maths Pathway community.

What do we stand for? Nothing less than a future in which every child who leaves school does so fully numerate and confident in their ability to think mathematically. We stand for an education resourced to prepare students for whatever they may dream for their future. One that allows them to fully participate in society, to pursue University, as well as the jobs beyond. Because if we're to meet the challenges of the future — like climate change and workplace automation — we're going to need all STEM-brains on deck.

In the six years since the birth of Maths Pathway, this stance has helped us grow from two teachers helping their own students, to a thriving network of more than 2,200 teachers across Australia.

As teachers we know that good practice is inclusive, explicit, and caters for individuals with targeted approaches proven to be effective. We are also acutely aware that change without the right framework and support will always fall short of the mark.

Walk into any café and throw a stone. You'd have to aim pretty carefully to find people who are comfortable with numbers. The aim of Maths Pathway is to change all that, one teacher and one classroom at a time.

But none of what we've achieved already, or our plans for the future, would be possible without our supporters and champions. So before we tell you about us, we want to offer you our sincere thanks:

- Thanks to the wonderful teachers who have been with us from the beginning, advocating for and helping to shape the Maths Pathway Learning and Teaching Model.
- Thanks to the members of our vibrant teacher community, whose willingness to share their experience has greatly improved the support we provide and powered our journey to becoming change management and implementation experts.
- Thanks to the academics and researchers who have inspired us, providing the insights that allow us to continue to refine our model.
- Thanks to the philanthropists who are helping us realise our dream of introducing Maths Pathway in every school by supporting us to ensure our great results are maintained as we scale up to reach more students.

We couldn't have done it without you. And please don't go anywhere. Until every child in every classroom is confident in their mathematics capability, there's still work to do.

Certified B Corporation

We're proud wearers of the B Corp badge.

We may look like a business, but at heart, we're a social movement, driven and dedicated to changing the world one maths-loving student at a time.

That's why we're part of B Corporation. Certified B Corporations balance purpose and profit, and are legally required to consider the impact of their decisions on their workers, customers, community, and environment. They also undertake a rigorous certification process that ensures they meet the highest standards of verified performance and transparency.

To find out more, visit bcorporation.net

For teachers, by teachers

Richard Wilson

Co-founder

Richard began life as a management consultant, before switching gears to dedicate his life to teaching. A native of South Africa and Teach for Australia alumni, he witnessed the radical equalising impact of education firsthand. It was his own experience as a classroom teacher that made him realise that nothing less than systemic change would be required to transform how maths was taught in the classroom.

Richard is the blue sky innovator and idealist. The one who wanders around HQ dreaming up new ideas, and who can always be counted on to understand how the latest educational theory or finding can improve the teaching of maths.

Justin Matthys

Co-founder

A member of the physics research group that discovered the Higgs Boson, Justin swapped his research career for one in teaching. A graduate of Teach for Australia, he was made a local Australian of the Year for his work with underprivileged youth and the homeless. Now, he dedicates his talents to changing the terrible truth that he experienced as a classroom teacher: despite teachers' best efforts, too many students were graduating with little to no understanding of mathematics.

At Maths Pathway HQ, Justin works tirelessly to ensure the Learning and Teaching Model is translated into the best possible tools, content and classroom routines. Justin lives and breathes innovation and will leave no stone unturned in the search to help teachers maximise the impact they have on students.

The Maths Pathway team

When you visit Maths Pathway HQ, you'll find educators, experts, thinkers, doers, creators and lifelong learners. Maths Pathway is made up of many teams — each with their own expertise and all committed to our cause.

The Learning team includes teachers, pedagogy experts and mathematicians. This balance of expertise creates the perfect synergy for the development of highly effective student and teacher resources.

Our Schools team are former teachers, change management experts and communication specialists who devote their time to working with schools through the implementation journey and beyond.

The tech gurus behind the Maths Pathway portal are the Engineering and Product insights teams. These UX designers, engineers and data specialists constantly strive to improve workflows and student-teacher experience.

Lastly, but certainly not least, our Support team. This team boast a combination of product knowledge, school administration understanding and a deep care for our teachers and students. They are the team responsible for day to day customer support.

But what we think makes our people special, is that we all share one belief — big change is needed in education so that every child can access an exceptional maths education.

That's what we're all passionate about and that's why we do what we do. We're dedicated to supporting you to build a better future for maths teaching and learning in Australia.

Education Advisory Board

The Education Advisory Board is a select group of education experts who contribute to the ongoing innovation and refinement of Maths Pathway's Learning and Teaching Model.

Collectively, the Education Advisory Board members have a wealth of expertise across mathematics education and school education policy and practice. They are forward-thinkers who are passionate about improving the education system for all young people.

Charles Lovitt
Maths Pedagogy Consultant & Co-creator of Maths300

Melodie Potts-Rosevear
CEO, Teach for Australia

Roslyn Prinsley
Head, Strategic Research Initiatives, Office of the Deputy Vice Chancellor, Research & Innovation, ANU

Sonia Sharp
Principal, Nous Group

Rob Randall
Former CEO of the Australian Curriculum, Assessment and Reporting Authority (ACARA)

Jacqueline Magee
Director, Learning First

Board of Directors

Our Board of Directors lend their extensive business experience and acumen to the governance and strategic direction of Maths Pathway.

Anthony Jon Bohm
Karen Elizabeth Bohm
William John Conn
Robert John McLean
Peter Murray

The classroom as it should be: our vision

NOTE FROM OUR CO-FOUNDER, RICHARD WILSON

When I walk through the world I see things differently. I notice numbers and the way they create patterns and relationships. I search for the connections between the abstract and the concrete. I compute 90% confidence intervals for the quality of my coffee. When my two year-old and I check our carton for broken eggs it becomes a counting exercise. When I go to a café with my five year-old it becomes an exploration of the difference between one coffee cup and zero cups, and whether zero coffee cups is equivalent to zero pastries.

But I'm not trying to do maths. Maths is just part of my identity.

I didn't use to be like this. I used to be like most of the population: numbers were vaguely threatening, 'maths' was something you used in school but probably never anywhere else and statistics were a tool used by politicians to influence the populace.

My mathematical 'awakening' came when I was nineteen years old and studying philosophy. While exploring the very real human experience of the passing of time, I realised that this supposedly vague concept could be described, evaluated and tested not just in traditional language, but in a uniquely expressive and symbolic language — mathematics. Imagine: you can actually write equations that explain why time goes forward and not backwards!

To be clear, I didn't have the mathematical knowledge to be able to do that at nineteen, but the very realisation that it might be possible changed my mindset about what mathematics was.

Most of the kids in our classrooms don't believe those things. Truthfully, most of the adults in our world don't believe them. 'I'm not a maths person'. 'Maths is for boys'. 'I was never good at maths'. 'Maths doesn't make sense.'

I came to believe that mathematics provides a beautiful and elegant way of thinking about reality, that my days are richer and more interesting for having this additional lens on the world, and that instilling a love of mathematics in all of us is valuable in itself.

Maths Pathway rages against these ideas every day. We came into existence to rage against it — and yes, I'm using the word 'rage' intentionally. How, as educators, politicians, philanthropists, and society-at-large can we accept this level of discomfort, of anxiety, of sheer terror when it comes to maths? By far the majority of our children finish school never really understanding maths, never seeing what is beautiful, exciting and powerful about it. The mission of the teachers, students, parents, schools and partners who are part of the Maths Pathway community is to make certain that the next generation sees all of that. We're going to ensure they walk into maths class and feel like this is the best part of the day.

What will success look like? Nothing less than a world that, for the first time in human history, understands and is entirely comfortable with mathematics. It will be a world that most of us won't even recognise — a population that can't be manipulated by 'statistics'; that can solve even the most complex social and scientific problems; whose interactions with each other are rich, deep and thoughtful.

This report chronicles the latest step on our collective journey towards that world. Explore it and see what we've learnt so far and how you can help bring about this new world.

> Every act of conscious learning requires the willingness to suffer an injury to one's self-esteem. That is why young children, before they are aware of their own self-importance, learn so easily.
>
> **THOMAS SZASZ**

The landscape of maths education

In the headlines

We all know the dismal facts and dire predictions. The number of Australian students choosing to study maths in the senior years of high school and beyond is shrinking[1]. According to projections by the Australian Bureau of Statistics, employment is predicted to increase in professional, scientific and technical services by 12% and in health care by almost 16% over the next five years[2]. Meanwhile, the STEM pipeline of primary and secondary students, graduates and job seekers is declining[3]. This is 'a major concern for industry,' according to the Australian Industry Group's CEO Innes Willox[4].

The 2015 PISA results comparing the performance of students internationally showed that only 9% of Australian students demonstrated advanced knowledge of mathematics, compared to 41% in the top five performing countries[5].

A 2017 study by Wienk[6] reveals that the proportion of Year 12 students electing to study senior mathematics is now at a 20-year low.

This is also confirmed by NAPLAN, which in addition to showing a small decline in the overall number of students studying maths, reveals a more worrying trend of students selecting easier subjects in order to maximise their university entrance scores[7].

Beneath such headlines are other worrying truths. The smaller percentage of girls, compared to boys, pursuing Advanced Maths and STEM careers[8]; the ongoing challenge of ensuring that merit is what predicts student success rather than socio-economic background[9]; the disaffection and underperformance of talented maths students and the loss of maths teachers to other professions due to the lack of support that would enable them to teach in ways they know are effective[10].

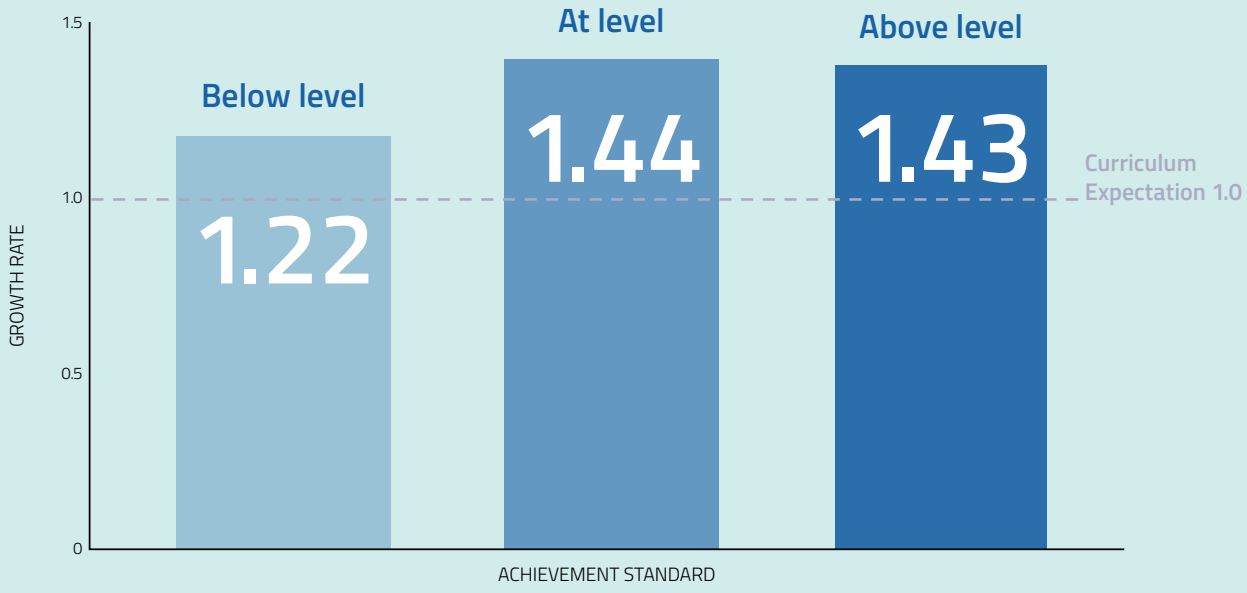
Our data shows that traditional ways of teaching maths will see an average of just 9% of students reaching or exceeding the expected curriculum standard for their year level[11]. This means that by the time these students enter Year 10, the vast majority are unprepared to continue their studies in maths related fields or to enter the workforce of the future.

Percentage of students at or above the expected curriculum level

n= 51,776

Maths Pathway student growth relative to their starting position

n= 51,776



In the classroom

Ask teachers and they'll be the first to tell you that the solution to the STEM crisis, and lack of mathematical understanding, begins in the classroom. It is in the classroom where the promise of an equitable, more just future can be realised. Teachers come into the profession with their hopes high and ideals intact.

But for many, the first few years of teaching can be crushing. Their time and energies consumed by marking assessments and endless photocopying to provide differentiated work to their students, while feeling the pressure to move them through the curriculum regardless of their readiness. This effort, combined with other pressures teachers deal with on a daily basis, can leave them feeling overwhelmed. The fact that up to 50% of new teachers leave the profession in their first 5 years[12] comes as no surprise.

There was no one thing that I could do, no one-textbook approach. Every student in my class was different. They demanded a new approach, a new relational connection.

EDDIE WOO, ROCKSTAR MATHS TEACHER AND AUTHOUR

Making classrooms more equitable

There is nothing more radical than providing equal access to quality education. Only when students' ability, will and perseverance determines how well they perform at school — not their socio-economic background — will Australian society be truly inclusive, equitable and just.

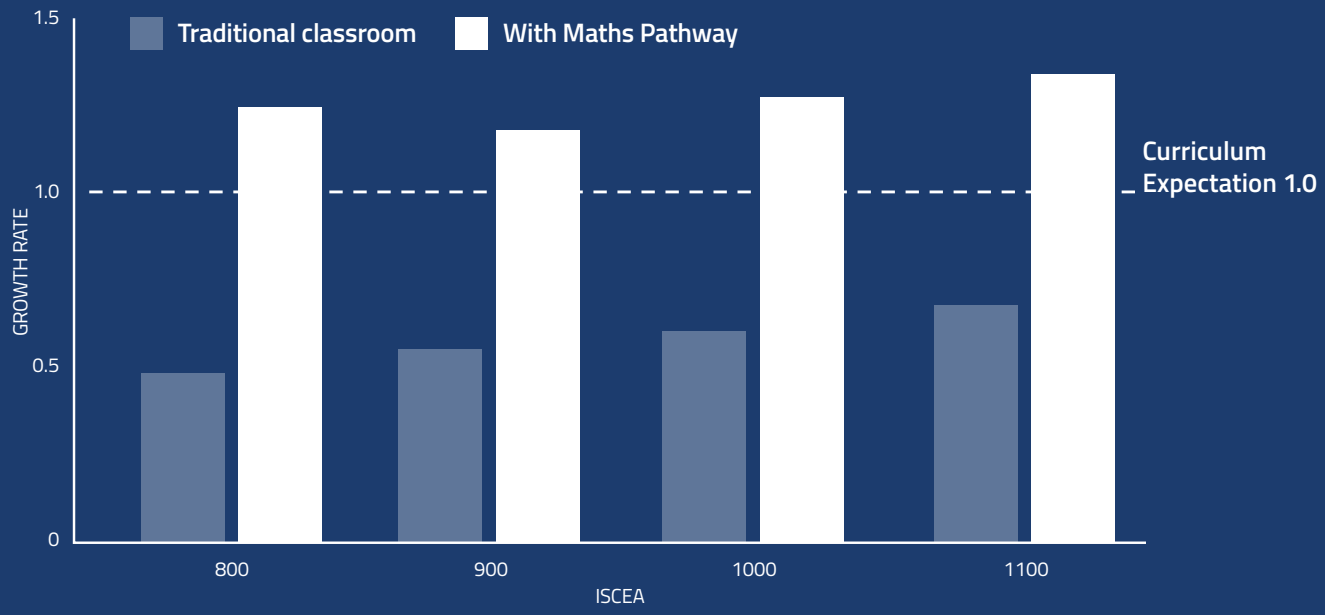
We're not there yet. In fact, things have gotten worse in Australia in recent years. PISA[13] and NAPLAN[14] figures show a growing gap in educational achievement related to socio-economic status. In maths, the achievement gap between the least and most advantaged students is significant. Students in disadvantaged secondary schools are making around half the progress in numeracy compared to students in advantaged schools. And in many cases, students in disadvantaged schools are making a lot less than a year worth of growth each year.[15]

Maths Pathway is pushing back against social inequity. In 2018, the mean improvement rate for students in disadvantaged schools was 2.61, compared to the still impressive improvement rate of 1.97 for learners in more privileged schools. In other words, Maths Pathway students in disadvantaged schools are rapidly catching up, providing a clear pathway for those deprived of the best start in life to achieve and excel.

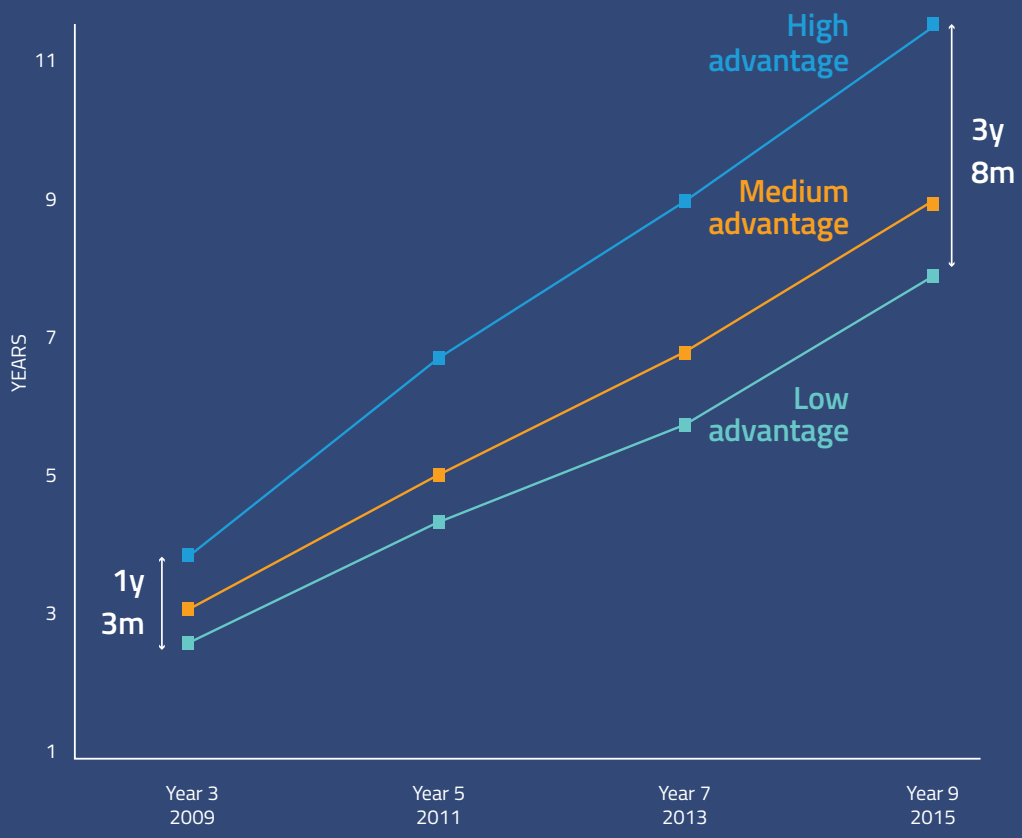
These results also support research findings[16] that leadership quality, school culture, consistency of teacher practice and teacher professional development are more important drivers for growth than size, sector, remoteness or socio-economic background. This is why the Maths Pathway model at its core is about teacher practice, providing schools with a scalable framework and supporting teachers and leaders through personalised coaching and ongoing professional learning opportunities.

Growth rate by Index of Community Socio-Educational Advantage

Everyone gets better and the level of socio-economic advantage makes less of a difference.



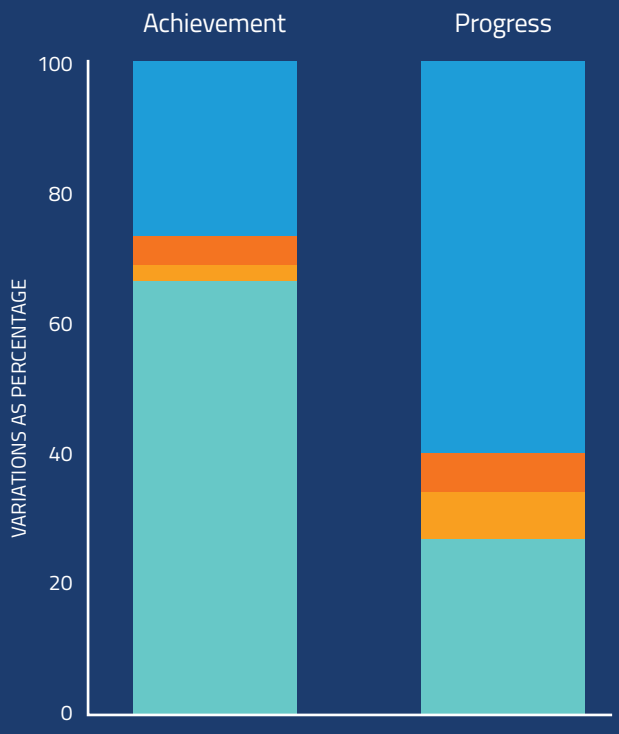
Students in disadvantaged schools fall behind between Year 3 and 9[17]



NOTES

Results show the estimated progress of students grouped by their school ICSEA. Low, medium and high advantage schools are the bottom ICSEA quartile, middle two ICSEA quartiles and top advantage ICSEA quartiles respectively. White values are the gap between highest and lowest groups. Coloured values are the years of progress gained from Year 3.

Proportion of school-level variation explained by school factors[18]



- Average school-level factors e.g. teaching practices, school leadership, student cohort
- State, sector, size and remoteness
- % Students with language background other than English
- School advantage

NOTES

'School-level' factors may include school practices or consistent patterns in each school's student cohort. 'School advantage' is measured by the Index of Community and School Socio-Economic Advantage (ICSEA). Data shown are R-squared values from multiple regressions of school-level performance in NAPLAN (in Equivalent Year Levels), averaged across relevant year levels and domains. The progress dataset includes 5 cohorts (2010-12 to 2014-16) for numeracy and reading and 4 cohorts (2011-13 to 2014-16) for writing. The achievement dataset includes 7 cohorts (2010 to 2016) for numeracy and reading, and 6 cohorts (2011 to 2016) for writing.

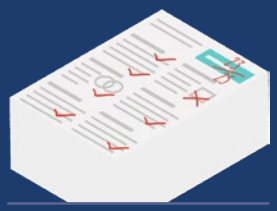
Our impact on Australian classrooms

Maths Pathway combines evidence-based practices to create a holistic model that is maximising teacher impact and increasing student engagement in maths classrooms across Australia.

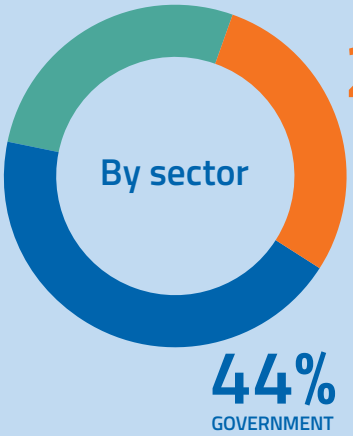
269
Partner schools

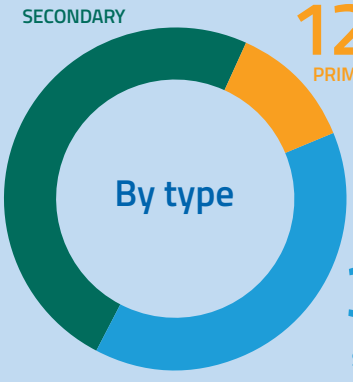
2,232
Teachers

57,137
Active students



566,517
Tests in 2018

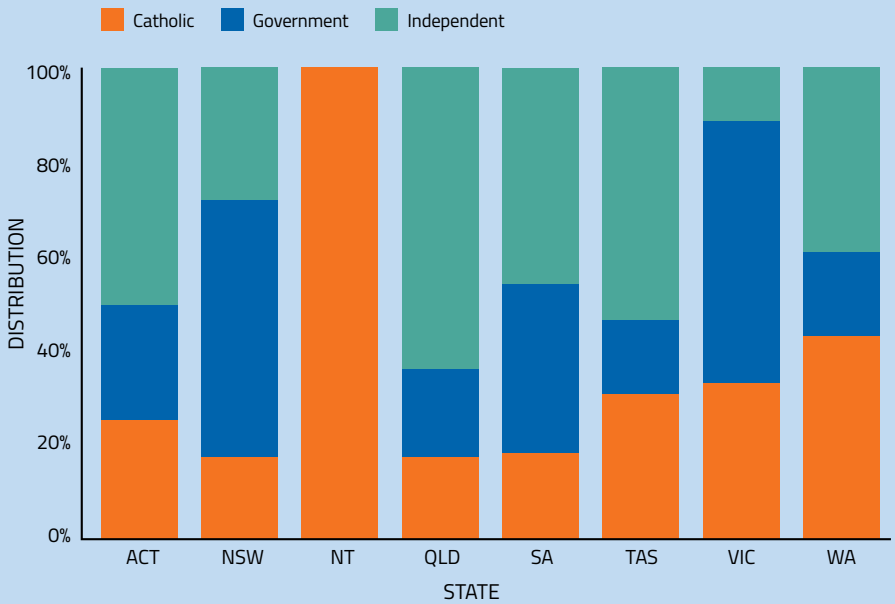


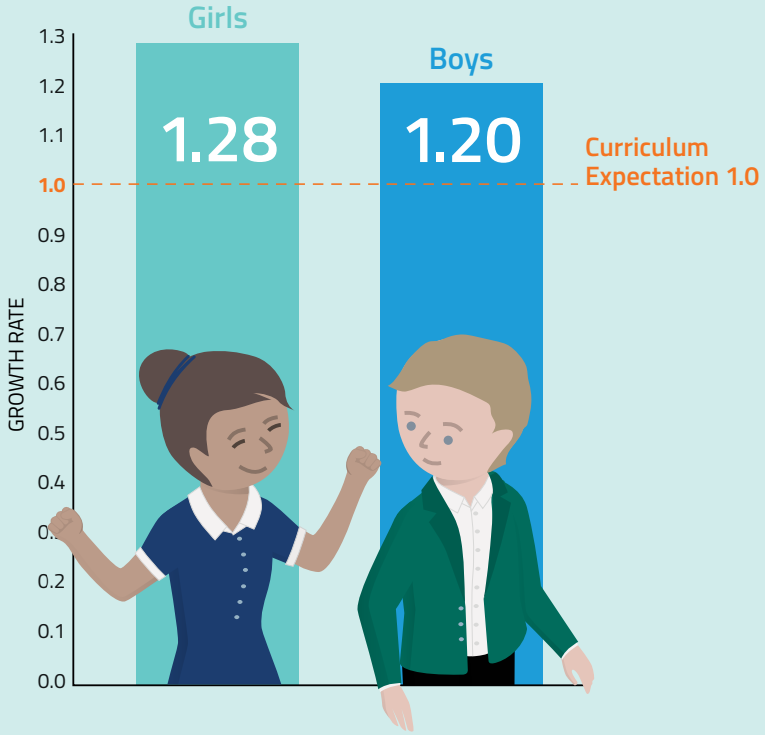


Schools distribution

Maths Pathway has a broad national presence with a similar distribution to schools across Australia.

Sector distribution by state





Students using Maths Pathway learn twice as much in a school year. When it comes to gender, our model ensures that boys and girls experience equal success.

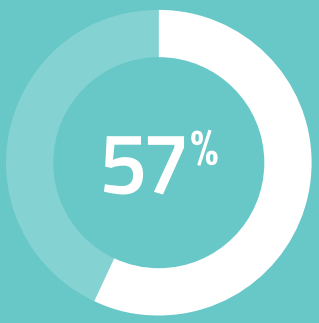
n= 51,776

Percentage of students predicted to be equipped for Advanced Maths studies and STEM careers

n= 45,732

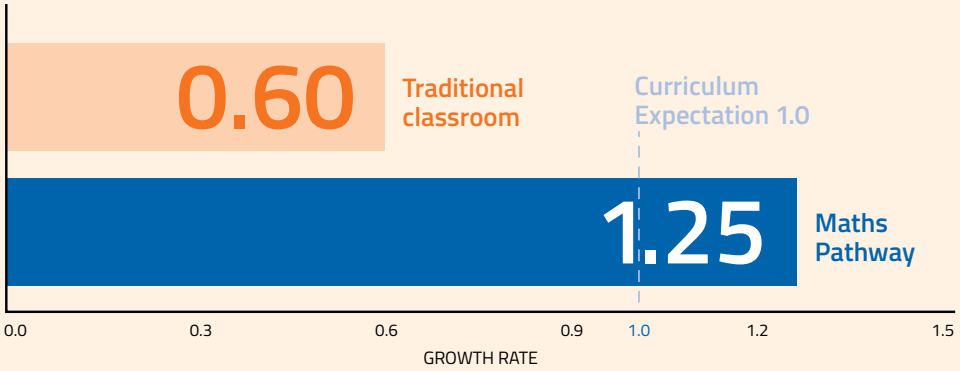
Traditional classroom

With Maths Pathway



Percentage of maths learnt over one year of schooling

n= 51,776

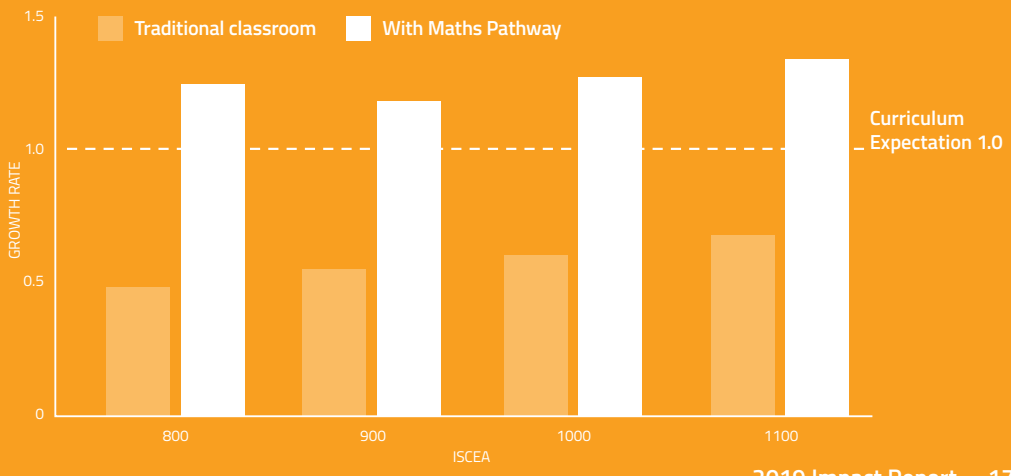


The Maths Pathway model works for every student. Meeting them at their point of need ensures every student's progress.

Growth rate by Index of Community Socio-Educational Advantage (ICSEA)

n= 35,291

Maths Pathway creates equity across schools from all backgrounds, giving every student the opportunity to grow.



Reconnecting teachers with their passion

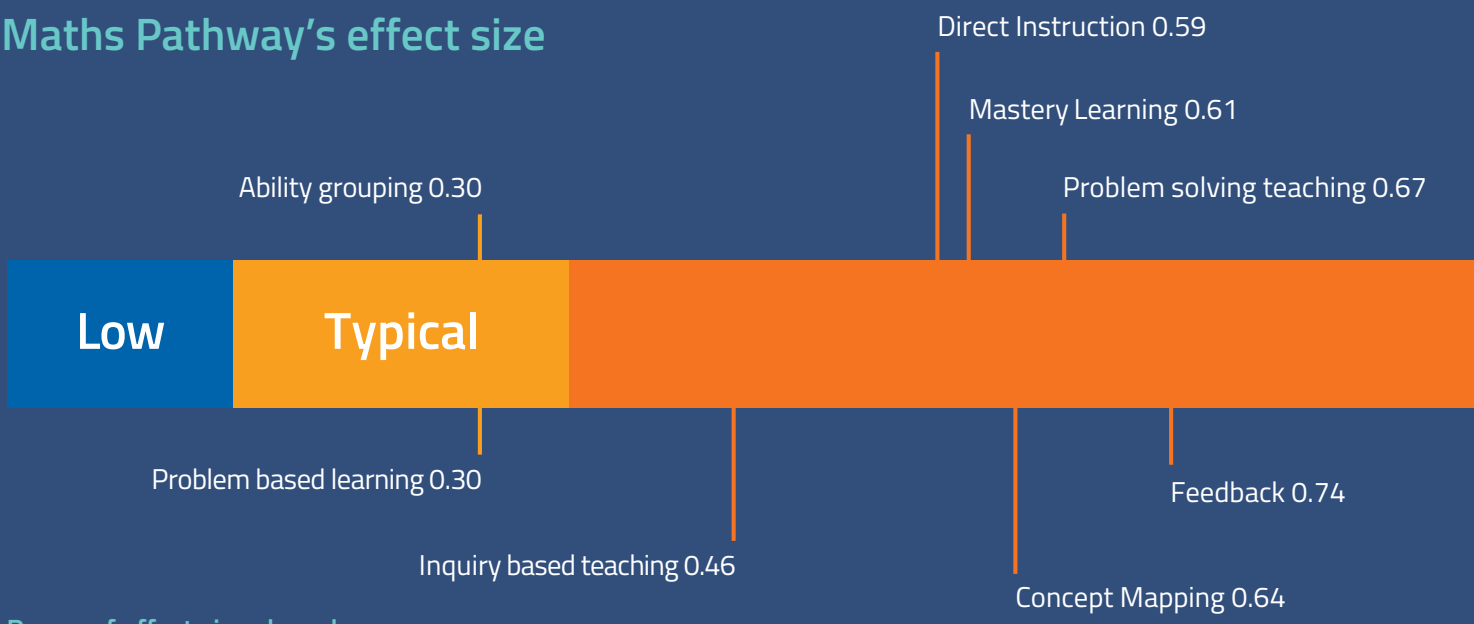
Evidence shows that 'collective teacher efficacy' is the strongest predictor of student achievement[19]. This means that teachers' self belief in their own capacity to positively affect students determines whether students learn. But the tough reality is that most teachers do not feel empowered to make a difference.

Maths Pathway combines highly effective evidence-based practices[20] with tools and strategies to create a holistic model that supports teachers.

Many of our components are included in the Visible Learning research, which synthesises findings from 1,500 meta-analyses of 90,000 studies involving 300 million students, into what works best in education[21].

Maths Pathway is not a substitute or replacement for teachers, but a powerful set of components that, when put into the hands of educators, magnifies their impact in the classroom.

Maths Pathway's effect size



Range of effect sizes by colour

We have just had the BEST two weeks with Maths Pathway! We've had much better ownership from our students over their effort and growth. They are actually articulating what they have done to achieve the growth in their tests and talking about what they need to improve next time.

ALANA FREER, MID-NORTH CHRISTIAN COLLEGE

Thanks for making Maths Pathway. Last Friday a girl went up to her English teacher bursting with pride and demanding to tell the teacher the great news — she got 200% growth on her Maths Pathway test. She said she had never felt so happy because she never got good marks in maths ever. The English teacher felt happy too! Now she wants English Pathway.

CHRISTOPHER HILL, EPPING SECONDARY COLLEGE

Maths Pathway 1.42

High Impact

Collective teacher efficacy 1.39

Effect size is a way of evaluating the impact of an educational approach or intervention. It is calculated by dividing the difference in the means of a control group and a 'treatment group', by the pooled standard deviation of the samples. For example, an effect size of 1.0 tells us that the means of the two groups differ by a standard deviation, representing what's considered a large effect size. The average effect size in educational research is 0.4. Effect sizes less than 0.15 are considered small, and interventions with effects greater than 0.4 fall within the zone of desired effects.

About effect size

Although the use of effect size has produced much conversation and innovation in education, like with all academic research, interpretation should be balanced. According to Coe, care must be taken with respect to effect size for educational programs and interventions. The word 'effect' connotes or implies 'causality' when in many cases there is an identified relationship and should be used only when it can be justified. We must also be careful when comparing or aggregating effect sizes when there are: **1.** different operationalisations of the same outcome, **2.** different treatments, **3.** different levels of the same treatment and **4.** measures derived from different populations.[22]

The Maths Pathway model: a solution to a centuries-old problem

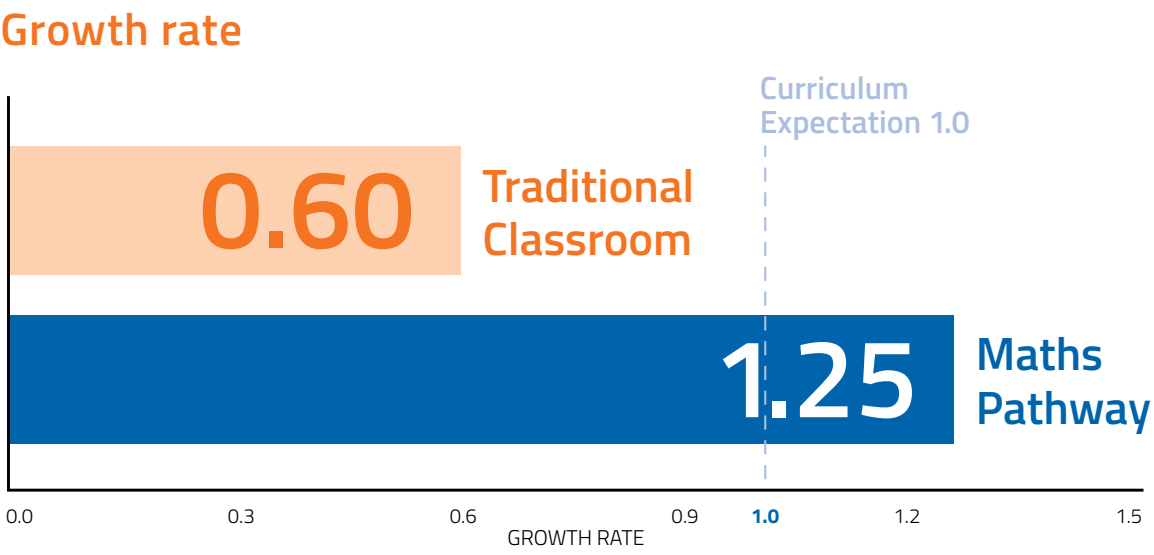
We don't claim to be a new idea or a magic online solution. In fact, the problems we solve are not new problems. The concept of teaching a student what they're ready to learn is as old as teaching itself. But that's exactly why we exist. We want to see every student make progress, wherever they happen to start from.

Maths Pathway combines different evidence-based practices to create a holistic model that is maximising teacher impact and increasing student engagement in maths classrooms across Australia.

A model for all students

The Maths Pathway model works for all students because it meets them where they happen to be in their learning journey. By applying high impact teaching strategies and focusing on growth, effort and work habits, students develop a growth mindset and become independent learners. As a result, our students master twice as much curriculum in one year as they would in a traditional classroom.

But don't take our word for it, the facts speak for themselves.

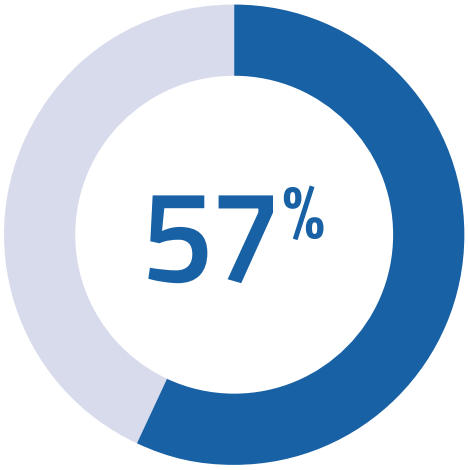


Percent of students predicted to be equipped for Advanced Maths studies and STEM careers by the end of Year 10

n= 45,732

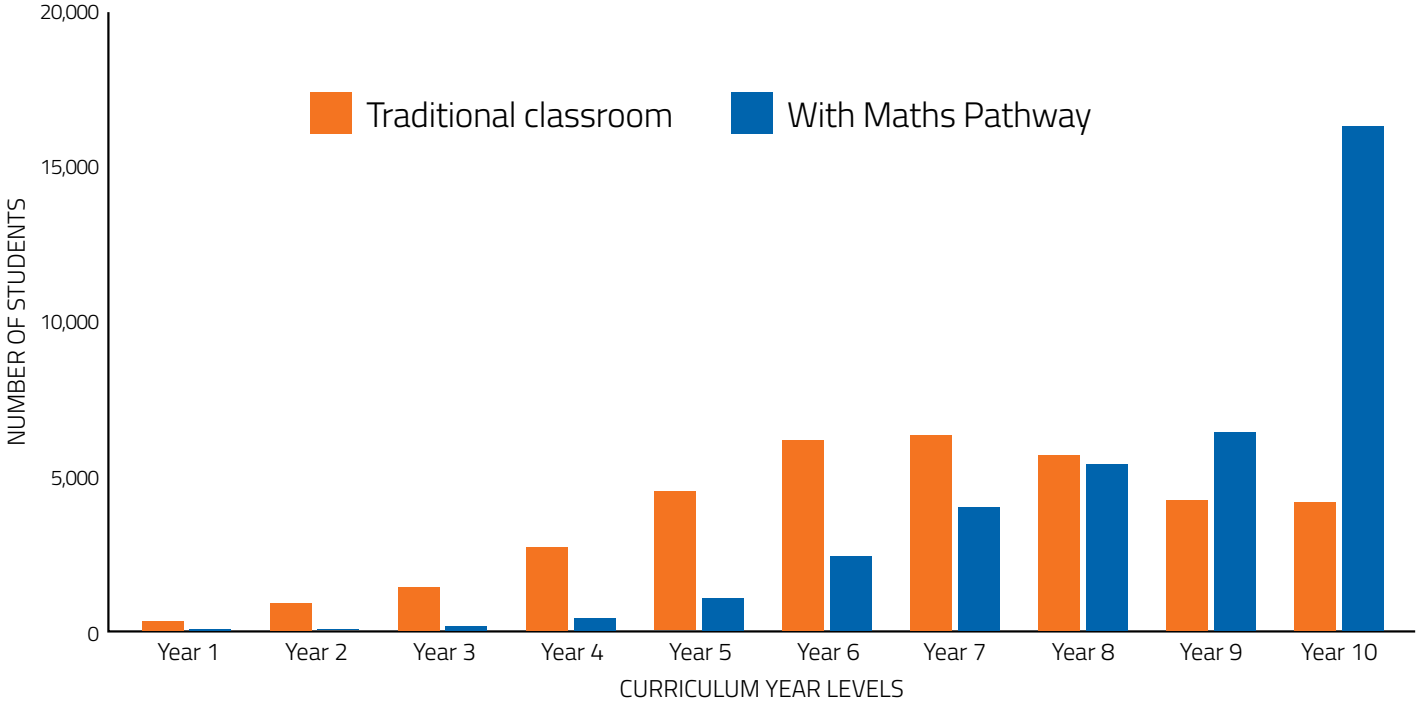
Traditional classroom

With Maths Pathway



Projected student achievement levels by end of Year 10

n= 45,732



No student held back or left behind

Supporting talented students to excel

The Head of Maths at Redcliffe State High School was constantly disappointed to find that year after year, the school's top maths students would 'hit a wall with their progress' and drop to a less challenging maths course — 'Something wasn't working.'

The loss of capable and keen maths students to non-STEM related courses doesn't get much media attention. But it is an important contributor to the overall decline[23] of Australian students studying senior mathematics at high school[24] and University[25]. The current focus on broad skilling and high ATARs is contributing to the low engagement seen in maths subjects[26].

The average Year 7 class has an eight year spread of ability[27], ranging from students who struggle to count to students who have a deep mathematical understanding and often lack challenge from aged-based content.

This wide range of levels creates an extremely challenging situation in the classroom. Despite teachers' best efforts, struggling students will not get the support they need to progress and the most advanced students won't be extended in their learning. As teacher Rose Nahilland told us, 'Having taught Year 8 maths for the past three years, I often felt that students at the top end were not being pushed to see how far they could go or improve.'

Maths Pathway enables teachers to personalise the learning experience for every student in the classroom. Students access the content they are ready for based on their diagnosed level.

Teachers support their learning through targeted instruction and Rich Learning, challenging high achieving students to excel while supporting students at and below the level to continuously grow. As Jacqueline Lee at Emerald Secondary College explains, 'We still need to be pushing top-level kids and not allow them to assume they're always going to get 99% on something. These types of students often give up when they get to Advanced Maths courses because they're used to things being easy straight away. Maths Pathway students learn to be pushed all the way through.'

Anecdotal data about increased enrolments in Advanced Maths courses suggests the model is working. At Lavalla Catholic College, teachers report a 25% increase in enrolments in Maths Methods among students who've been using Maths Pathway since Year 7. Their NAPLAN results have also improved, with students beating the state average.

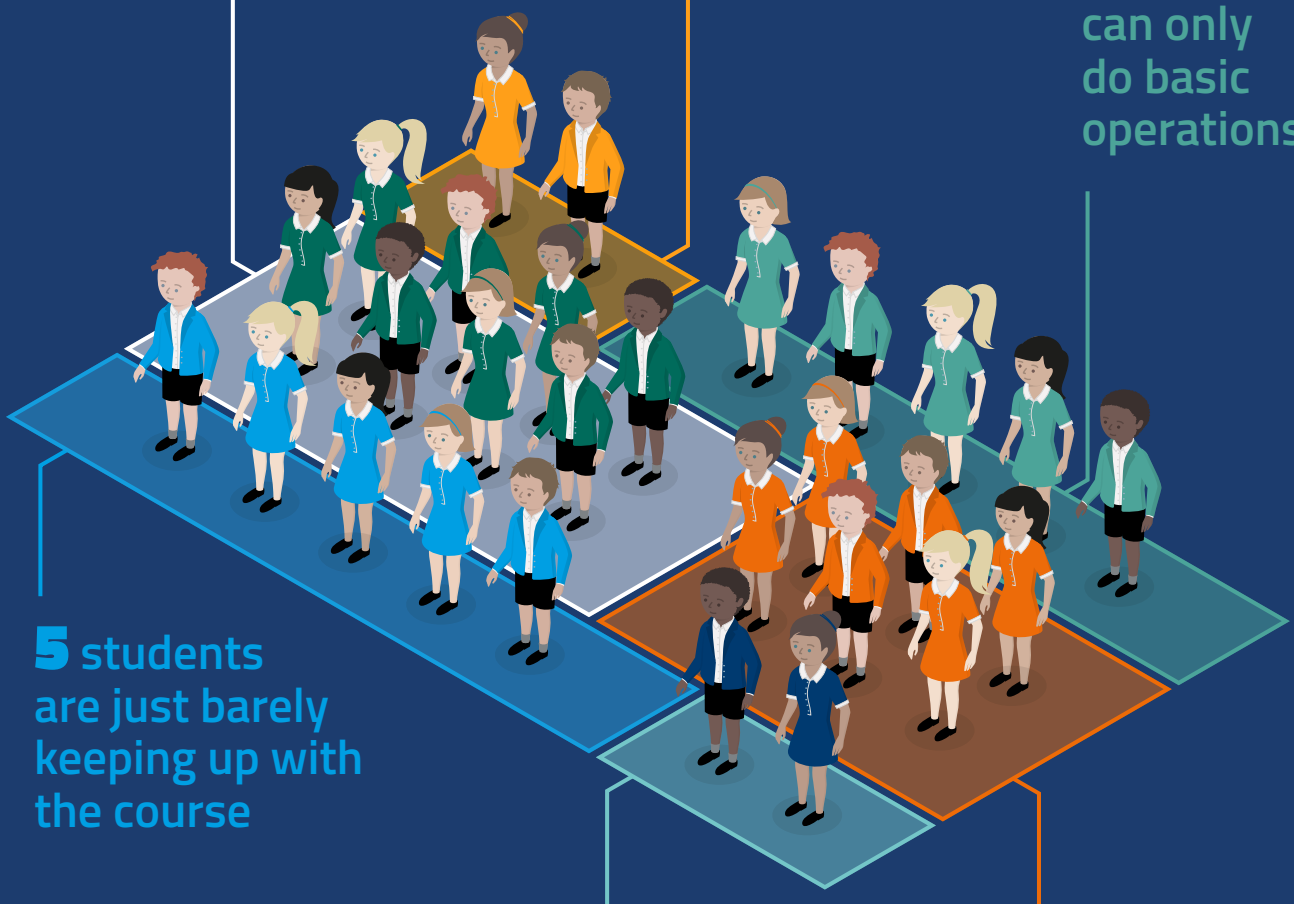
Galen College reported an increase in demand for both the Year 10 preparatory program and Year 11 Maths Methods classes, while the demand for basic numeracy classes has halved. Maths Pathway has also allowed Galen College to advance Year 9 and 10 extension students to senior mathematics while keeping them with their year-level cohort. This ensured that critical relationships and experiences weren't disrupted, something that had proved to be impossible with traditional acceleration classes. At Brighton Secondary College, 41 students are more than six months ahead of their expected year-level. Before implementing our model in 2015, only five students were in this group — a remarkable improvement.

The eight year spread of a typical Year 7 class

8 students have huge gaps in their early primary learning

2 students can't count yet

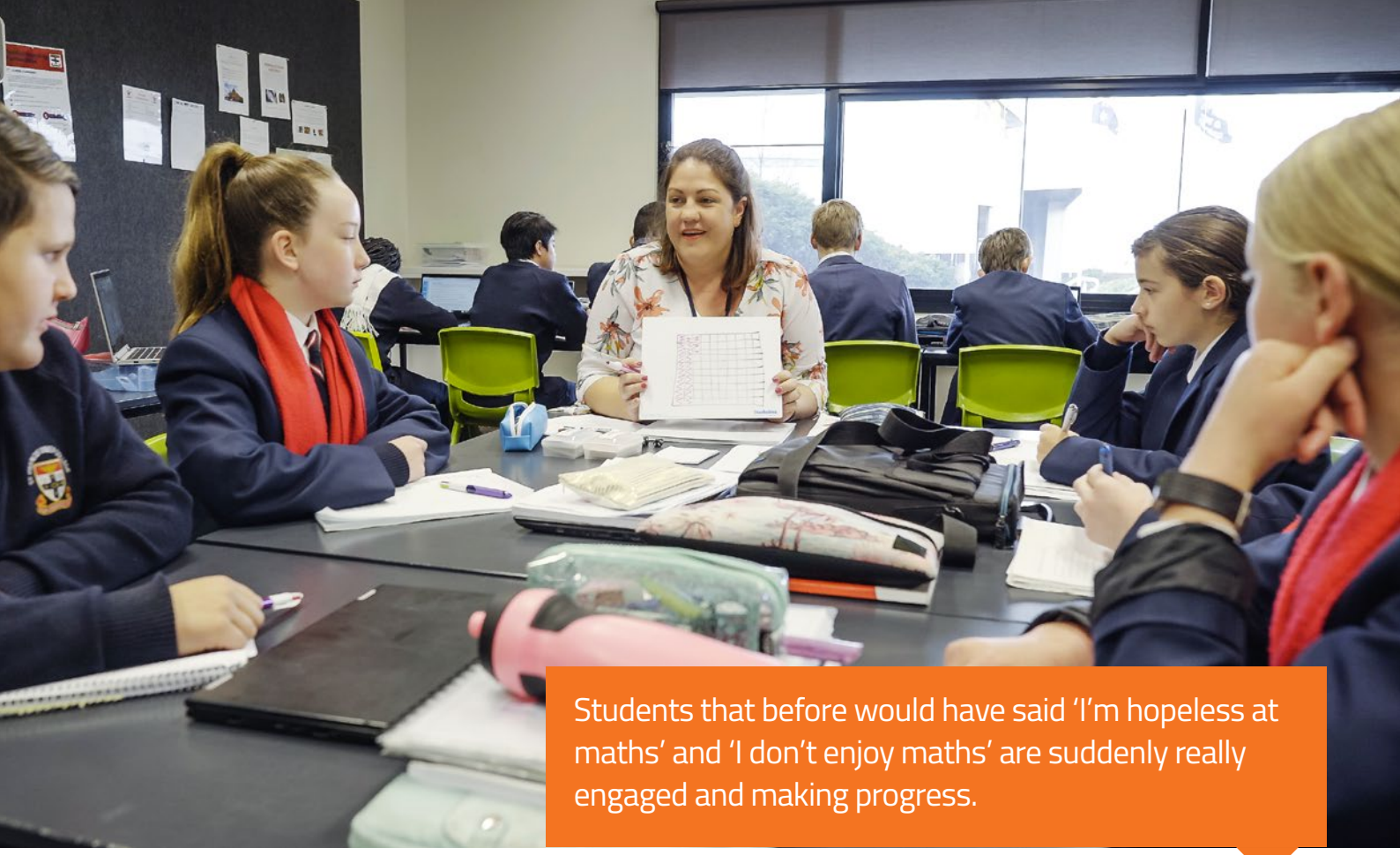
5 students can only do basic operations



5 students are just barely keeping up with the course

2 students have deep understanding

6 students can only follow step-by-step recipes



> Students that before would have said 'I'm hopeless at maths' and 'I don't enjoy maths' are suddenly really engaged and making progress.

LOUISE MANSFIELD, ST PETER'S COLLEGE

Our vision for all classrooms

Step inside a Maths Pathway classroom, and you know you are somewhere special. Students look engaged as they work to their personalised learning plan, independently or in pairs. They look forward to spending one-on-one time with their teacher to reflect on their progress just as much as joining a small group of students to take part in a mini-lesson. Immersing themselves in a project or Rich task is the highlight of their week, where they deepen their understanding and problem solving skills in a playful setting.

The soundscape is one of constructive industry: students working independently, collaboratively or with their teacher, abuzz with a sense of purpose, accomplishment and excitement about maths. Students are in charge of their own learning, excited about the progress they are making everyday.

Growth mindset is not just a colourful poster hanging on the classroom wall — it's embraced by everyone — mistakes are encouraged because they present an opportunity to learn.

Teachers are happy with the growth and engagement experienced by all of their students. After all, this is why they became teachers. Outside of the classroom, they never feel unsupported. They are part of a community of more than 2,200 teachers changing maths classrooms in Australia. They know that help is always at hand with their School Improvement Consultant who is available to provide regular advice, be their sounding board, and facilitate professional development.

As you watch all of this unfold, the moving parts begin to fade into the background leaving you with a new sort of classroom — a welcoming and safe learning space full of happy students and fulfilled teachers.


GROWTH MINDSET
Today: Mini-Lessons
3D shapes
Jess
Nick
Tania
Dan

Look inside the classroom of the future

You'll see eight components working together, supporting teachers to have a greater impact and helping students to grow and succeed in maths.

This is our vision for the perfect classroom — one that we're bringing to life in schools across Australia.

Eight components, one holistic model

Each component in the Maths Pathway model is impactful by itself, but its true power is in the carefully designed structure and the relationship between components. In our model, the whole really is greater than the sum of its parts.

Personalised learning

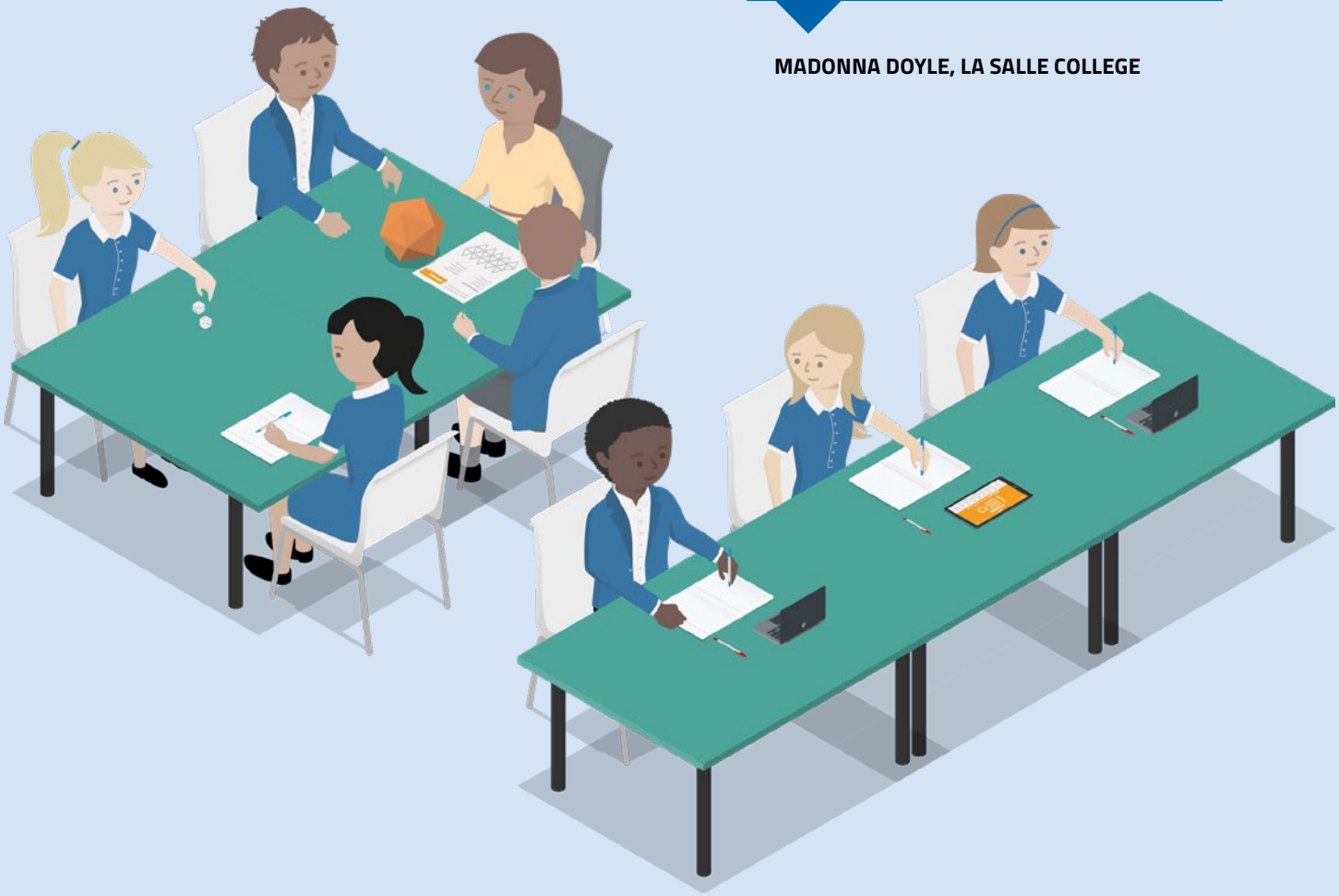
The average classroom has an eight year spread of ability[28]. Maths Pathway uses advanced diagnostics and ongoing formative assessments to provide granular data on each student's gaps and competencies. By identifying each students' learning profile — what they have mastered, what they are ready to learn next, and what gaps may exist — Maths Pathway gives students the curriculum mapped content they are ready to learn. This ensures students work within their Zone of Proximal Development, being challenged enough to remain engaged but given plenty of opportunity to experience success.

Targeted explicit teaching

Explicit teaching works[29]. But the wide spread of ability in the classroom means teachers can't use this strategy effectively when teaching an entire classroom at once. Students who are below the level fall further behind, while those above fail to achieve their potential. Those at level are likely to rote learn as they fail to truly understand the subject. These conditions, where most students are unable to experience success, cause many to disengage.

Having access to real-time data allows teachers to identify and group students with similar needs and deliver impactful, stimulating, and personalised instruction. Lessons are conducted with small groups of students who have a similar understanding of a key concept or have comparable learning needs, giving them the opportunity to problem solve, ask questions and think critically.

> Thank goodness someone has done something right in education!
>
> **MADONNA DOYLE, LA SALLE COLLEGE**




3·091 and 3·109

> Rich tasks are humming!
> Our kids are loving them!
>
> **SANDRA LIPINSKI, SILKWOOD SCHOOL**

Rich Learning

A Rich Learning task is one that engages students and develops critical thinking, reasoning, and problem solving skills. Our Rich tasks are developed in partnership with Dan Finkel, maths teacher extraordinaire and the founder of Math for Love. Dan embraces Rich tasks as a way for teachers to connect mathematical ideas from across the curriculum, spark students' curiosity and encourage productive struggle — promoting student agency.

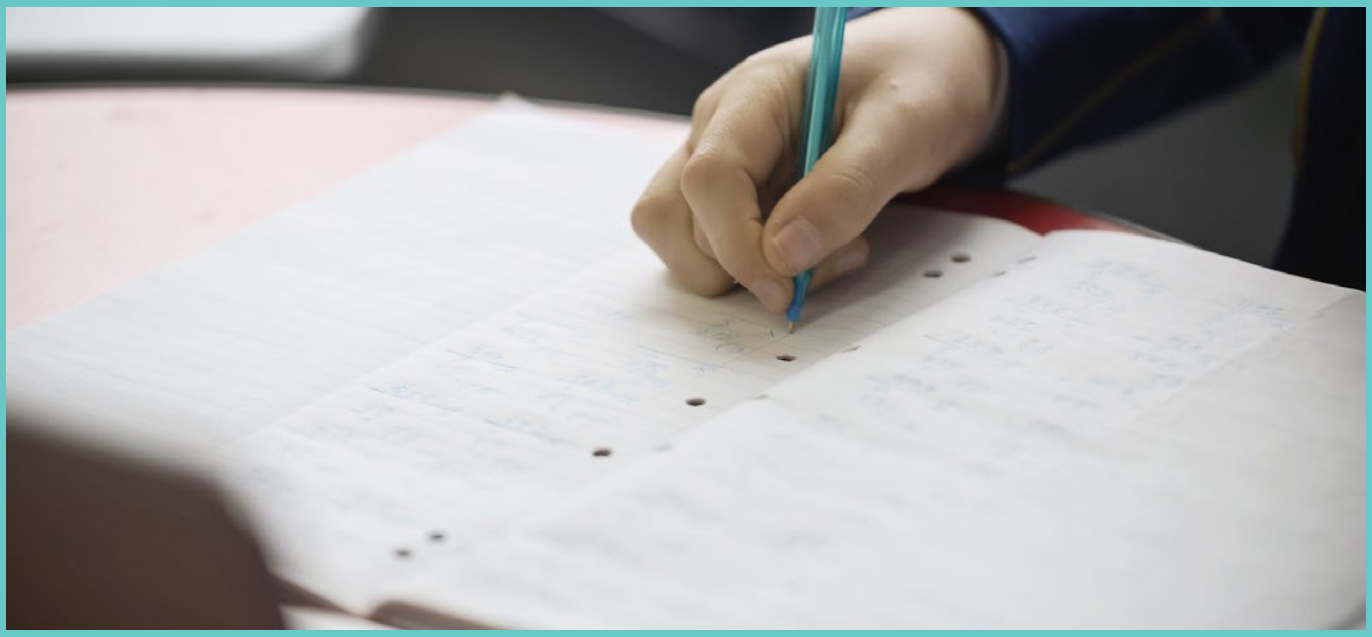
Rich Learning tasks and projects allow students to explore mathematics in novel and real-world contexts, moving them beyond the dot points of the curriculum and allowing them to demonstrate and extend their learning. Students are encouraged to think like mathematicians and explore the world of maths in an exciting and playful way.

Curriculum mapped content

Maths Pathway's content is aligned to each state curriculum, covering mathematics from Years 1 through to 10. Our carefully scaffolded modules of work build students' understanding, fluency, problem solving and reasoning skills. Worksheets include fully worked solutions to each of the questions, as well as a short instructional video that supports the introduction of new concepts. Students are exposed to routine and non-routine scenarios that prepare them to solve real life problems effectively. Teachers have access to detailed lesson plans for each key concept in the curriculum, as well as a library of Rich Learning tasks with detailed instructions to proficiently run these activities with their class.

Differentiated assessment

Every student's learning journey is different. But in a traditional classroom each student is assessed on the same aged-based content. Maths Pathway uses ongoing formative assessments to inform what each student should learn next or keep working on. This component is essential for effective personalised learning to gather real-time data and enable timely feedback and intervention.



Data-informed feedback

Thorough data from diagnostics and fortnightly differentiated assessments is organised into actionable, live dashboards giving teachers granular data on every student. This allows them to provide meaningful feedback that is regular and timely. Students with similar learning profiles are also automatically grouped to assist teachers in delivering targeted instruction.

Custom term or semester reports can be generated, exported and shared through different school learning systems.

School Improvement Consultant

Schools are complex environments and Maths Pathway is not a magic solution that schools can pick up and take away. Our model is an important change to the way mathematics is taught and demands proper implementation. That's why we provide schools with their own School Improvement Consultant. These dedicated specialists assist and guide schools through the implementation process. They provide ongoing strategic advice, coaching and support to ensure schools make the most of each component of the model.

Professional growth and development

We want our students to be lifelong learners, but what about teachers? Continuous practice improvement requires commitment and ongoing professional development. So does change management. In our six-year journey we've become experts at educating, advising, and supporting teachers. We provide tailored training — both in person and online — at every stage of your Maths Pathway journey.

A proven approach

Informed by research

The Maths Pathway model is synthesised from the important work of educational researchers and innovators like Robert J Marzano[30], Jo Boaler[31], Peter Goss[32], Dan Meyer[33], Dan Finkel[34] and Dylan William[35]. It represents the best collective up-to-date knowledge we have about high-impact teaching, including effective classroom strategies and powerful learning tools.

Real-world feedback

Maths Pathway began as a labour of love by teachers, for teachers to improve maths classrooms. As teachers know better than anyone, learning is a process, not an outcome. Research changes, best practice updates and every year more schools become part of the Maths Pathway community. That's why our most important data source continues to be our community. Feedback from teachers and leaders at Maths Pathway partner schools and data from more than 57,137 students from 269 schools around the country, informs us about what's working and what's not so we can improve our model year-on-year.

The power of community

It takes a village to raise a child. Turns out, it takes a village to teach that child maths, too. A community of dedicated teachers to stare down the naysayers and do the hard yards to bring the model into their school and bed it down properly; a dedicated group of School Improvement Consultants — many of them teachers themselves — to be there to support teachers; a committed group of school leaders prepared to do what's right, even if it's not easy. This isn't just a job. It's a mission. Because we believe that teaching students with Maths Pathway is the right thing to do.

We really see the development of the person from child to adult and that's an amazing transformation.

MICHELLE FRY, REDCLIFFE STATE HIGH SCHOOL


Roll
Morning Tea
Home Time
be CHEERFUL & pass it ON!

Our outcomes

Growth rate

Maths Pathway students learn at more than double the rate of students in traditional classrooms.

Student ownership

Our model helps students to develop a growth mindset and encourages them to take charge of their own learning.

Efficacy

Students who switch from a traditional classroom to Maths Pathway are learning 108% faster.

Equality

Regardless of gender, all students grow and experience success with Maths Pathway.

Equity

In our model, socio-economic background is not a determining factor for student success — all students see significant improvement.

Best practice

Maths Pathway puts many of the reforms called for in the Gonski 2.0[36] review into practice. Our model is research and evidence-based, combining high impact teaching strategies and effective learning tools.

In the end, for teachers it's all about the students: encouraging their self belief, growing their capability in maths and igniting their passion for learning.

One student was weaker at maths and she didn't really have a positive view of it. But after starting with Maths Pathway her growth is celebrated alongside her more capable peers. It's not about how good she is at maths in terms of the traditional levels — it's about how much progress she's making. That's had a really big impact on the way she sees herself as a maths student.

LOUISE MANSFIELD, ST PETER'S COLLEGE

Kids who had a phobia of maths — it's disappeared. Kids are coming to class, and excited. They're even disappointed when they can't have their maths lesson for other reasons.

MELISSA STEPHENS, MILL PARK SECONDARY COLLEGE

When they finally put all the puzzle pieces together the excitement and the 'Miss I got it. Come look at this. Come and see!'

EMMA LAKE, CHEVALIER COLLEGE

Two of our students who were using Maths Pathway received State awards in the Newcastle Maths Competition. The program works!

LIZ BEASLEY, GLENROI HEIGHTS PUBLIC SCHOOL

Helping girls find success

In the early years of schooling, there is barely any gender divide in maths. But by age 8, a clear gap in self perception of mathematical ability develops in female students[37] one that widens as they enter high school and often they decide against pursuing maths in senior year levels[38].

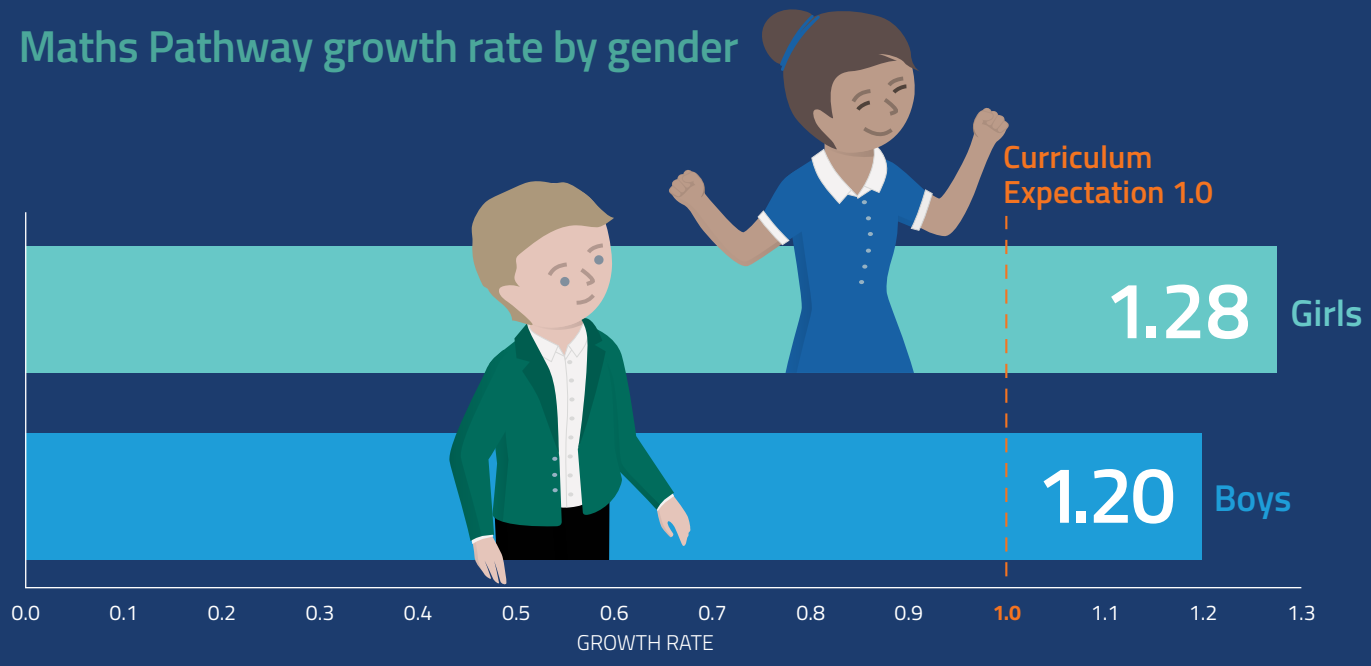
This is not because girls don't recognise how useful maths can be to them later in life, including in helping them to pursue their desired career. They do. But lower levels of confidence and higher performance anxiety[39] are likely connected to what studies show as a lack of interest — and liking — of the subject[40 41].

Maths Pathway addresses all aspects of this problem. The model is designed around mastery learning[42]. Students work in their Zone of Proximal Development[43 44] and with the fundamental understanding that they must actively construct their mathematical understanding from existing knowledge[45]. This in turn requires a hierarchical learning paradigm wherein each piece of new learning has strict prerequisites that must first be met[46]. In other words, students can only conceptually understand a new piece of maths if they have already mastered everything that leads to that point.

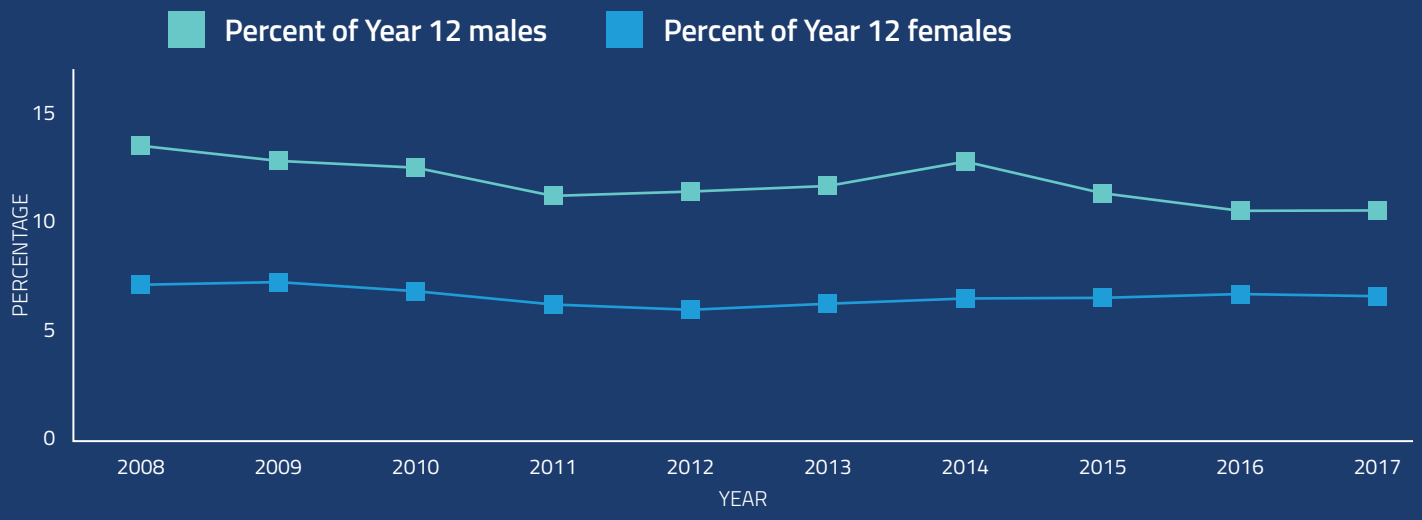
The model is centred on rewarding accuracy and effort and encouraging productive struggle, students develop perseverance and resilience and take ownership — becoming intrinsically motivated learners.

This approach enables student growth, regardless of gender. The average female student in 2018 learned 1.28 years worth of maths curriculum in 12 months, exceeding the already impressive growth rate of 1.20 achieved by male students.

These findings tell an important story. That all students in Maths Pathway classrooms are more than doubling the amount of maths they master every year.



Percent of Year 12 students studying higher mathematics by gender[47]



Fatima's Story

"My name is Fatima, I go to Glenroy College and I'm in Year 7. I really like maths. It's my favourite subject. Some people look at the numbers and freak themselves out, but we use Maths Pathway and that makes it really easy. People work at their own pace and it helps them. They don't have to be 'Oh my god this is too hard for me' or 'this is too easy for me.' It's like perfect for them. I started at Year 6 level and I was really struggling, but now I can work Year 9 stuff really easily. I could not have gone this far if I didn't do Maths Pathway because they would obviously be teaching me Year 7 stuff and I was working at a Year 6 level, and I would have been freaking out and I would probably have been below. Now, I'm around 9.5. I can't do Year 10 stuff yet. I try but it's too hard for me. But I keep working on it and I think I'll be able to do it in a little while."

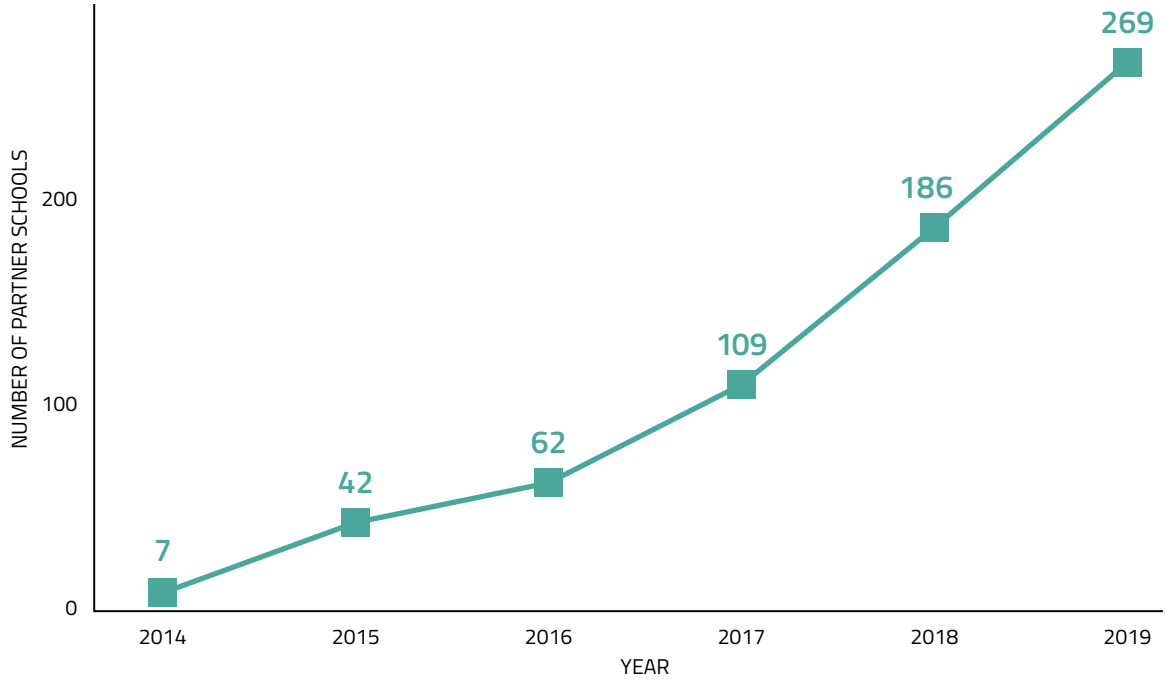
An invitation to transform maths education

Teachers have made Maths Pathway what it is today. The faith the earliest adopters had in the model was humbling, and their tireless campaign to see it implemented at their schools, transformative. We began life as a social business, but with all the energy in the room, we started to feel more like a social movement — a teacher-led, grass-roots push to improve the quality of maths education available to every Australian student.

Now, six years later, the vision remains strong, as does the exponential growth of the Maths Pathway community.

If you know that real change is needed, join us. Together we can transform maths education for future generations.

Growth of schools



Since starting with Maths Pathway, I think the community has been one of the best features. The teachers from across the different schools and states are all so supportive. You can feel that there's a buzz around the place, people are so excited about what's happening at their schools and with their kids.

MELISSA STEPHENS, MILL PARK SECONDARY COLLEGE

Data methodology

In Australia, tools commonly used to examine a student's level of achievement in mathematics include the National Australian Program — Literacy and Numeracy (NAPLAN)[48]; the Progressive Achievement Test in Mathematics (PAT-M)[49]; and the On-Demand Testing Program[50]. All three employ a specific type of Item Response Theory called the Rasch Model[51]. In this approach, a specially constructed test is administered to a student, and the number of correct responses is counted. This provides a measurement of the student's 'latent trait', which can be thought of as their overall position on a continuum, along with a margin of statistical error. The statistical model allows this to be done using a relatively short test (say, 40 questions)[52].

The measurement approach used by Maths Pathway is fundamentally different, because it is constructed for a very different purpose: to target teaching to point of need. Knowing a student's overall level of achievement (with or without statistical error) is not enough to achieve this aim, because two students sitting at the same overall level can have very different learning needs. Instead, Maths Pathway gathers data directly on each distinct learning objective across the entire curriculum, spanning levels 1 through to 10A, without relying on statistical inference. This data makes it possible to determine the set of learning objectives which sit within the individual student's ZPD, but necessitates a much longer test (typically hundreds of questions long). In practice, students complete this diagnostic assessment in multiple sessions spread out across a semester; and adaptivity which leverages non-statistical inference keeps the test length to a manageable size (using the set of known clear relationships between connected learning objectives; for example, single-digit addition and multi-digit addition).

The result is a detailed learning profile for each student. That profile consists of a vast number of learning objectives, arranged into distinct levels following the structure of the *Australian Curriculum: Mathematics.* For each learning objective for each student, there exists evidence to show either that they have, or have not yet achieved the objective. This learning profile is updated each learning cycle — typically 16 times per year — to include the updated direct evidence of what the student has achieved.

It is worth noting that this approach amounts to 'criterion reference' measurement, which has been suggested as a more suitable approach than the Rasch Model for educational measurement because it does not rely on an assumption of 'unidimensionality of ability[53]'. This assumption is that there is only one underlying trait which determines a student's response to assessment items; rather than one trait governing algebraic item responses, and another trait governing geometric item responses for example. Despite having no unidimensional latent trait, Maths Pathway learning profile data can be abstracted down to a single 'overall level number', as a function of ACARA's arrangement of learning objectives into a level structure in the *Australian Curriculum: Mathematics.*

This overall level of achievement is derived by summing the proportion of learning objectives which have been achieved at each level. This accounts for both gaps from lower levels, and competencies from higher levels. This means that the overall level of achievement increases whenever the student learns something new.

An explanation of the data analysis within this report

In 2018, there were 57,137 students using Maths Pathway. Not all of those students, however, have been included in every mean or distribution calculation. In general, only students with data that is sufficiently 'complete' from the whole year are used. This equates to 51,776 students (or 90% of the total population of Maths Pathway students). The following section breaks down the analysis performed on Maths Pathway data, in order to calculate the key findings within this report.

Diagnosed level

The diagnostic assessment that every student undertakes when they begin using Maths Pathway establishes their achievement level in line with the *Australian Curriculum: Mathematics*. Year 7 students in 2018 who had sufficiently complete data were used in the measurement of this metric, equating to a total of 13,176 students. When considering students from low ICSEA backgrounds the number of students measured was 10,406, as a small number of schools do not have ICSEA data and are therefore excluded.

Our data comes from 269 schools representing 2,232 teaches and 57,137 students. The learnings from this data are fed back into our model so we can better serve every teacher and student.

Measuring growth rates

Student growth rate refers to academic progress made over a defined period — the amount of new mathematics that a student learns in that period, expressed as a proportion of the average amount of new mathematics a student would need to learn every year between Year 1 and Year 10 in order to have mastered all of the mathematics content and skills up to and including the end of level 10, by the end of Year 10. Prior growth rate is measured by taking a student's diagnosed level when they began using Maths Pathway and averaging it over the number of years they have attended school. Note that in the interests of estimating the impact conservatively this is a best case estimate of prior growth, because it assumes that students learn all of their mathematics at school, and none prior to starting school. In reality, prior growth rates are probably lower.

Effect size

Effect size is a way of evaluating the impact of an educational approach or intervention. It is calculated by dividing the difference in the means of a 'control group' and a 'treatment group', by the pooled standard deviation of the samples. For example, an effect size of 1.0 tells us that the means of the two groups differ by a standard deviation, representing what is considered a large effect size. When calculating effect size, the 'control' group refers to the growth rate of students in Maths Pathway schools if they had continued to grow at the rate they were growing prior to using Maths Pathway, and the 'treatment' group refers to the set of Maths Pathway students in 2017. The average effect size in educational research is 0.4. Effect sizes less than 0.15 are considered small, and interventions with effects greater than 0.4 fall within the 'zone of desired effects'[54].

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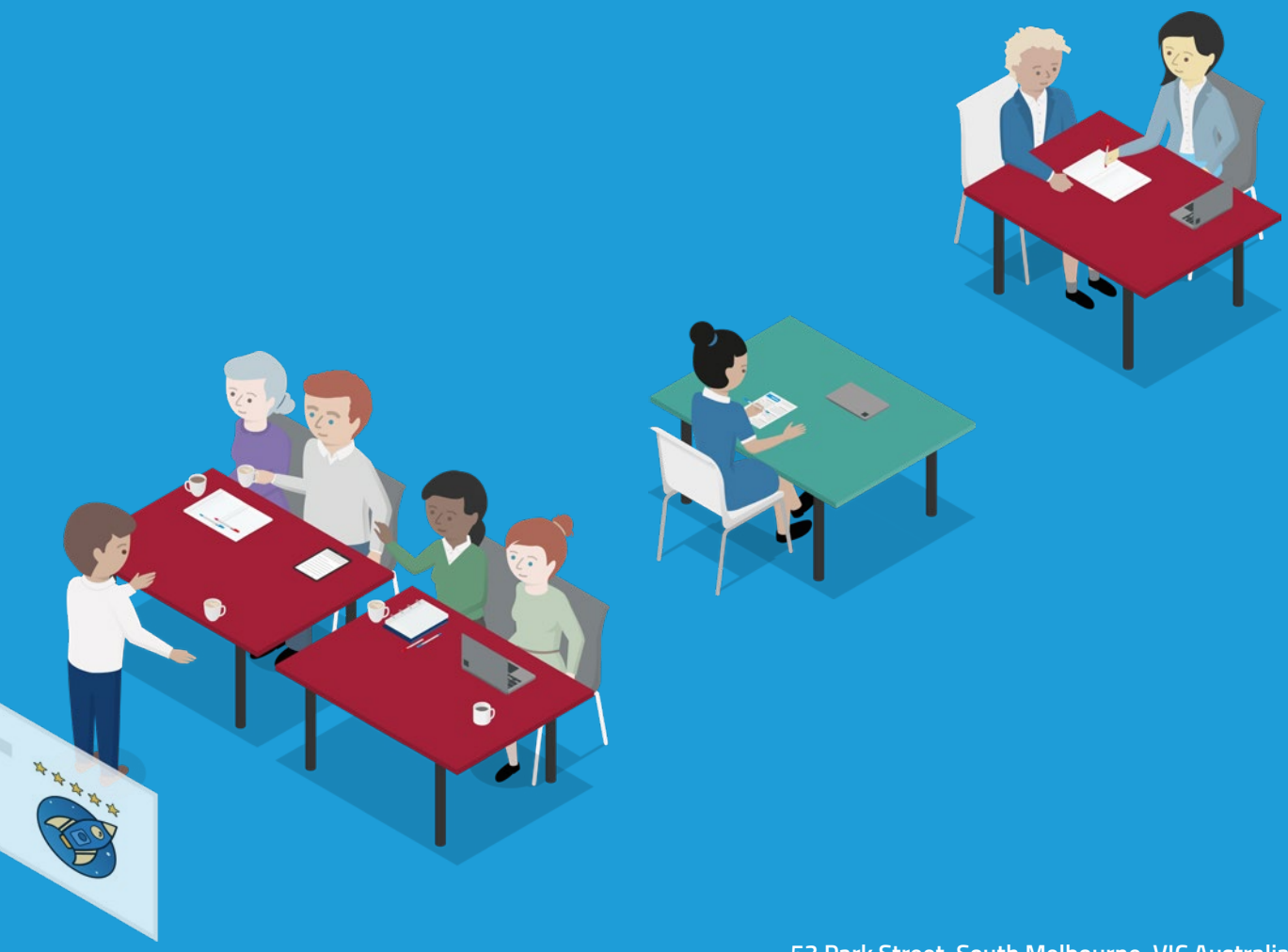

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