How Australia can lead the way in shaping educational technology for the social good

A brief introduction to a complex topic

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Leslie Loble AM is a recognised leader of public purpose reform in Australia and the U.S., with a substantial track record delivering major organisational and policy innovations in education and related economic domains.

Currently, she is a director of government and not-for profit entities, Industry Professor at UTS, a Fellow of the Paul Ramsay Foundation and the Centre for Policy Development, among other appointments.

Leslie served as Deputy Secretary in the NSW Department of Education for 20 years, driving strategy, innovation and delivery in Australia's largest and most diverse education sector, across schooling, early childhood and tertiary education. She was long-term chair of the influential Schooling Policy Group, a core part of the Australian Education Ministerial Council, and was appointed by governments to some 20 boards and advisory committees. Her national leadership helped shape major school funding reforms, teaching quality, literacy and numeracy assessment and VET innovations. In NSW, she led Australia's first-ever

guarantee of two years' preschool and established the recognised Centre for Education Statistics and Evaluation, Centre for Learning Innovation, and Catalyst Lab.

Leslie was appointed a Member of the Order of Australia (AM) in 2022, named one of Australia's top 50 school education innovators in 2019 and an Australian Financial Review/Westpac Top 100 Women of Influence in 2013.

Prior to coming to Australia, Leslie was appointed by President Bill Clinton to high-level executive roles, including Chief of Staff to Labor Secretary Robert B. Reich, Counsellor to the Secretary and acting Assistant Secretary for Policy. She holds degrees from Harvard University and Cornell University.

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1

A welcome from Leslie Loble
Paul Ramsay Foundation Fellow

I have been drawn to education, innovation and social justice over my entire working life for the way they can propel opportunity and drive shared progress. To close Australia's education gap, I believe we need to consider every possible resource at our disposal.

This means exploring the potential the best quality AI-enabled educational technology ('edtech') offers for much greater personalisation and enhanced learning. There is considerable promise in these tools, and it is encouraging that some of the best quality products are starting to show significant positive impacts on student learning when used appropriately.

We have to remain optimistic about our ability to creatively meet the challenges that AI-enabled technologies are posing. We must embrace opportunities to design and use these tools for good, but with our eyes wide open, making sure to put in place the rules and incentives that will lead to positive rather than negative impacts. The alternative – letting narrow interests influence technology and sacrificing our collective agency – is unacceptable.

AI is now much better understood than it was even a few years ago. We use AI all the time, and we can see how beneficial it can be in our lives. Yet it's also a disruptive – and sometimes even dangerous – technology that will have lasting effects on our communities, both socially and economically.

Any technology used in schools must be part of teacher-directed learning. Teachers are the most important single influence on student outcomes. Technology never could or should take their place, nor replace their expertise. One way to support teachers is to help them access and effectively use the best quality edtech, so they have confidence that these tools are backed by strong evidence that they really work. In such a critical area as education, technology absolutely has to be shaped with very specific learning purposes and quality in mind, and with guarantees that it's ethical and safe to use.

What follows is simply a brief, accessible introduction to this complex and fascinating topic. I strongly encourage anyone who is curious about edtech to read the **full research report**, where you will see that I have presented both the promise *and* the peril of AI-enabled edtech. Since future technology is shaped by the decisions we make now, I have also laid out concrete actions we can take to make sure that people working in every facet of education, policy and philanthropy get actively involved in designing, testing, studying and governing these powerful tools.

My findings were informed not only by rigorous academic research but by in-depth conversations and thoughtful discussions with over 150 people from a wide range of backgrounds and diverse perspectives: from education, the technology industry, public policy and government, and public purpose organisations. What I discovered through that process was heartening and inspiring: across the board, everybody wants to help figure out how to make these products work best for education and overcoming disadvantage.

Leslie Loble | November 2022

The issue at hand:
How can we use educational technology to disrupt education disadvantage?

Many of us understandably feel a tiny bit suspicious of any technology that claims to be 'educational.' Parents see their kids get lost in a distracting digital world of bells and whistles. Australian educators who are already overwhelmed by the heavy workload of teaching don't always have the time – or wider school resources – to be able to figure out which educational technology ('edtech') tools might work best for them in the classroom.

While the global market for artificial intelligence (AI) and machine learning applications is expanding, there's a lot of confusion at the moment as to whether these new edtech tools are of any educational value – let alone if they can help disadvantaged or special needs students as much as their peers. Many of the edtech tools currently in use in Australia are advertised directly to schools by companies who are not required to explain the pedagogical underpinnings of their platforms, and some of these tools have not been designed with substantial input from educators. The pace at which AI-enabled technologies are being developed is overwhelming, and regulation and public policy lags behind private sector innovation.

Policymakers, meanwhile, are cautious about rolling out AI-enabled edtech in Australian schools because there are thorny ethical issues related to its use, such as privacy concerns about harvesting data from children, or the potential problems of bias or discrimination being invisibly embedded in these tools. They're also wary of regulating these edtech apps and programs – despite the growing consensus that rules are needed when it comes to AI, and that clear standards will help the industry align their work to what the Australian community values.

> Edtech has the potential to do great harm or great good – but educators are not yet empowered to be able to tell the difference, or to shape which kinds of edtech are adopted in schools.

There is too much at stake for us not to pay very careful attention to exactly what kinds of edtech are being developed, by whom, and to whose advantage. Instead of being on the back foot, Australian policymakers, educators and social purpose organisations could be seizing an important opportunity to scrutinise and shape these tools so that they meet the needs of Australian students – especially those who are disadvantaged, or have complex needs.

These tools can be used to disrupt education disadvantage, but this will require a mix of bold leadership, practical initiatives and targeted incentives. The goal of my **full research report** is to help guide this governance, information-sharing and consensus-building process in concrete and useful ways.

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3

Why does this matter?

In our highly networked, internet-dependent societies, those families and communities that can easily access and afford fast and reliable internet connections and quality digital devices, and thus develop strong digital literacy skills, are at a huge advantage compared to those who cannot.

The digital divide refers to this growing gap in access to modern digital infrastructure and everything it enables: online education, opportunities, employment and skills.

For disadvantaged students, accessing advanced edtech learning tools is set to become the next frontier in the digital divide.

The digital divide is often compounded in education settings for disadvantaged students. Not only are they not able to access the same digital resources as their more privileged peers at home, they are left even further behind if under-resourced schools are unable to harness existing technology to improve teaching and learning outcomes.

Disadvantaged Year 3 students in Australian 2021 NAPLAN results were two years and five months behind students from advantaged backgrounds – a gap that widened to more than five years by Year 9.

The existing education disadvantage gap is more like a chasm in Australia, especially in the wake of the COVID-19 pandemic. The impact of the digital divide became even more starkly evident during long periods of enforced remote learning despite the tireless and heroic work of teachers, who cannot be expected to overcome foundational digital challenges on their own. We need to learn from that difficult experience and take the initiative in advocating for the development of the right kinds of edtech tools, ones that benefit all Australian students – and not just passively accept whatever edtech is on offer.

Why should we invest education resources in edtech?

The development and reach of AI-enabled edtech will only expand in the coming years. It's our collective responsibility to make sure that only the best quality, safest, most effective and equitable edtech is used in Australia, and that all students (especially those who are already disadvantaged) have access to it.

> It's estimated that more than a billion students globally are potential edtech consumers. The international market for digital instruction tools is booming, but Australian investment is minimal – especially compared to the U.S. and China.
>
> This means that the edtech used in our classrooms is not being designed with our own national learning goals or curricula in mind.

Thanks to decades of trusted education research, we already know which factors have been proven to lift education outcomes for disadvantaged students.

One of the most important is encouraging effective classroom learning strategies that provide targeted and compelling instruction to all students, especially those who are disadvantaged or have complex needs. This can be particularly challenging where there's a wide range of student ability in any given classroom.

Edtech tools – especially in their infancy, as they are now – can sometimes be hit and miss, and are definitely not a magic bullet that will fix education disadvantage. Yet as these tools improve (with input

from educators and guidance from policymakers, plus responsive design by tech companies), there are ways in which they can be very effectively used in classrooms. Good quality edtech, when used by well-trained educators, can amplify positive outcomes for all students.

> A randomised control study across three high-poverty rural American elementary schools found that students in classrooms where teachers used a smart teaching support tool (containing instructional material and learning resources) scored significantly higher on a standardised reading assessment.

Yet it's never as simple as purchasing an edtech tool and automatically expecting it to work safely and well. Teacher professional development linked to the effective use of these tools is crucial. Edtech cannot be used with a 'set and forget' mentality: as with any targeted teaching aide, it is not a replacement for engaged, teacher-led instruction in the classroom. It's simply another tool that teachers can add to their toolkit – but first they need to trust that the tools work, and feel confident using them to enhance their impact.

> Not all edtech is created equal – we need to know what works, and why. Is the tool alone enough to make a difference? Or is the effective, skilled use of that tool by properly supported educators more important?

How can edtech improve education outcomes?

The good news is that there is a growing body of high-quality research on the effective use of edtech tools in various settings. One of the goals of my **full research report** is to do a deep dive into that research.

> In 2018, a disadvantaged public primary school in the Greater Western Sydney region began to use the *Lexia Core5* literacy platform. The school's NAPLAN results improved after introducing the adaptive learning tool as part of teacher-led literacy instruction, particularly for Year 5 students.

There are many different types of edtech. In my report, I do not consider more controversial and untested edtech (like social robots or biometric monitors), but rather focus on three edtech categories that have the most potential (backed by evidence) to be useful in closing the education gap:

1. **student-oriented edtech** (such as intelligent tutoring systems)

2. **teacher-oriented edtech** (like smart curriculum platforms, or diagnostic/remediation tools)

3. **school-oriented edtech** (such as early warning systems that crunch systems data to identify at-risk students and target support)

> There is reliable evidence that edtech can, in the right environment, improve learning outcomes for disadvantaged students.
>
> But there's a caveat: my research shows that this is only the case when edtech is well-designed, well-used and well-governed.

Certain tools in each of these three edtech categories can be used to enhance teaching and learning strategies that have already been proven to work in classrooms. See the examples below for some concrete illustrations of these kinds of edtech in practice (but please note that these are not intended as endorsements of particular products, since more research is needed on what is best-suited to Australian education contexts).

We already know that explicit instruction works in the classroom, when learning goals and the knowledge and skills to achieve them are clearly communicated to students. **Intelligent tutoring systems** can provide additional explicit instruction to learners, and can encourage student self-awareness about what they need to know (and steps to get there).

> The adaptive reading program *Lexia Core5* explicitly identifies when a student has difficulty with a particular skill, provides specific instruction, and further scaffolds the remaining steps of the task. Teachers can access student progress data and other resources to help with classroom lesson planning.

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6

Formative assessments that let teachers monitor student learning progress *as it occurs* – and adjust their teaching practice as needed – have been shown to be highly effective. **Digital formative assessment platforms and dashboards** can give teachers real-time feedback about the varying levels of student understanding or mastery within a diverse classroom – and help them direct extra attention towards students who are struggling.

> *Education Perfect* provides quizzes and other assessments to gauge student understanding of lesson material. Dashboards deliver data to the teacher on correct/incorrect answers, number of attempts, response time, and which questions have been particularly challenging for the student or class.

Smart curricula tools can direct teachers towards high-quality, evidence-based, 'proven in practice' teaching resources and lesson plans.

> *Inquisitive* lesson plans clearly state the learning intentions of each lesson and provide teaching notes to help students meet those goals. Teachers are supported to demonstrate solutions to class tasks, and can scaffold and differentiate activities based on student capabilities.

> A recent Grattan Institute survey of 5,442 Australian teachers and school leaders found that more than 90% of teachers do not have enough time to prepare effectively for classroom teaching, and 86% "always or frequently" do not get enough time to do high-quality lesson planning.

Digital tools that can detect/remediate learning difficulties can help to identify students with special needs (such as dyslexia or dysgraphia) and connect teachers to remediation resources that are proven to be effective.

> The *Dynamilis* app is used to detect and remediate dysgraphia (difficulties with handwriting). *Dynamilis* uses a machine learning algorithm to detect dysgraphia on a commercially available tablet within 30 seconds, with 96% accuracy. Teachers can use the tool to create individual sequences of learning activities to target a student's needs.

Data-driven school and system insights can be generated and analysed to allow teachers and school leaders to understand complex factors leading to student success or disengagement and connect that to appropriate early intervention and support.

> *Brightbytes* has partnered with the American Institutes for Research to develop and validate indicators that predict student progress towards high school completion and readiness for university.

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7

What are the determinants of quality in edtech?

Four ingredients are vital to ensure the quality of edtech products across their life cycle, and to prioritise learning gains for disadvantaged students:

+ **Co-design** with teachers, educational experts and others
This must go beyond simple user-testing, so that professional teaching expertise and curriculum relevance are embedded in the tools, and principles of inclusivity and equity inform design goals.

+ **Evidence-backed pedagogy** and learning science
A high-level survey of some 200 edtech products currently on the market found only a quarter provided even limited information on the pedagogical evidence or approach informing their design. Transparency about the learning science that underpins each tool is crucial to the quality and safety of the application, and fosters educator trust.

+ **Research and evaluation** of impact and implementation factors
At the moment, research into edtech is concentrated in the computer and data sciences, with not enough independent, applied research into how these tools are used in specific teaching environments, and how this affects their impact on outcomes.

+ **Data privacy and protection** through regulation and ethical industry behaviour
Current data privacy regulation in Australia and overseas does not include enough specific protections for children in terms of how their data is harvested and used. Regulatory agencies can play a role by strongly enforcing data protection regimes for children, and requiring the developers of edtech tools to make their data collection and use processes transparent and ethical.

How can edtech be effectively and appropriately used in the classroom?

Teacher professional development in using these tools is a key factor in their success or failure. Product sales teams may offer training in the tool itself, but the positive impact of these tools is more closely aligned with teacher and school expertise in knowing when, how and with which students an application will be most beneficial.

More research is needed to develop recommended usage guideance to avoid the overuse of edtech tools in the classroom. Findings from early studies suggest that edtech is more effective when its use is limited, highly targeted and integrated into the teacher's learning plan.

The research on adaptive learning tools so far shows that optimum outcomes occur when they are:

+ **Integrated intentionally into school and teacher planning,** programming, reflection and learner feedback;

+ Backed by **effective pedagogy for using technology;**

+ Anchored by **a commitment to support rather than replace or undermine teacher-led instruction;**

+ Linked to **a school or teacher's confidence in using student-level data;**

+ **Limited to relatively short periods** for each technology session or curriculum block.

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9

Are other governments and philanthropy organisations around the world already thinking about this – and taking action?

Australia is currently lagging behind other countries (like the U.S., the UK and Singapore) in proactively getting involved in shaping and improving the edtech tools on offer, and ensuring that they are safe, fair and effective in classrooms.

Educators and policymakers internationally are creating incentives for the edtech they use to be developed *locally*, so that any tool made available is directly linked to their own country's national learning goals, curricula and student needs.

Governments overseas have also already recognised how important it is to independently evaluate edtech curriculum resources, based on proven evidence of their impact. These comparative evaluations are made freely and easily accessible to educators and parents so that they have agency – and confidence – in choosing the right edtech tools.

> The UK's quasi-governmental organisation NESTA works with industry to design social benefit technology. Its sister entity EEF researches and ranks the effectiveness of teaching and learning interventions, including edtech tools.

> In Singapore, the Ministry of Education's *Education Technology Plan* prioritises developing digital literacy and instruction programs for schools, to support personalised student learning and provide digital teaching resources and learning analytics to teachers.

Some of the world's largest charitable organisations – such as the Bill & Melinda Gates Foundation, the Jacobs Foundation, and the Carnegie Foundation – have recently increased their investment in the edtech space. They have elevated their intent to catalyse reform and incentivise edtech providers to design and roll out tools that improve learning outcomes for disadvantaged students.

> The non-profit Global Innovation Fund invested US$2 billion in *Mindspark*, an intelligent tutoring system developed in India. *Mindspark* has had significant positive effects on Hindi Language and Maths achievement for students from impoverished backgrounds who participated in a randomised control study.

> Funded by major U.S. philanthropy organisations, *EdReports* was launched in 2015 to help school districts in the United States identify high-quality teaching resources (including digital and smart curricula tools). Teams of expert educators review these resources for alignment with curriculum standards, as well as ease of integration and professional support.

> The Annie E. Casey Foundation provided seed funding for the independent Johns Hopkins University-based *Evidence for ESSA*, a searchable website backed by rigorous assessment of the evidence supporting education interventions (including edtech tools). Each intervention is measured against the education evidence standards in the U.S. *Every Student Succeeds Act* (ESSA). The Bill & Melinda Gates Foundation supported expansion of the website.

> The UK-based 5Rights Foundation has partnered with the Institute of Electrical and Electronics Engineers to create a child-centred software design standard for advanced learning technology.

How can Australia take the lead?

The current global investment in edtech with social purpose is still quite low. Overall, not enough edtech research or development has focused specifically on disadvantaged students, and some studies of edtech impacts show learning progress in general, but no greater gain for lower-achieving or complex-needs students.

There is an important opportunity for Australian educators, tech entrepreneurs, social justice organisations and philanthropists to lead the charge globally in developing and testing edtech that is specifically created for **social good** – to improve learning outcomes for all Australian students, and especially disadvantaged and/or special needs students.

This is why the key recommendation of my **full research report** is the establishment of an **Australian Forum on Quality Digital Education**, with a network of members from across industry, education, philanthropy, government and academia committed to technology for widespread benefit.

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11

What needs to happen next?

The full report presents a detailed set of recommendations for every part of the education ecosystem in Australia, and I encourage you to read that report to understand the breadth and scope of the suggested actions needed on this issue. A strategic combination of policies, investment and institutional leadership can bend the curve of edtech development towards benefitting disadvantaged students. This will require purposeful interventions at key points of leverage: governance, investment, information-sharing and consensus-building.

In short, there are practical steps to be taken now that can have an immediate impact:

Policymakers can develop better governance and clear rules and standards for edtech products; require transparent proof of evidence-based pedagogical design underpinning edtech; and firmly regulate the use and collection of any data from children. They can also create novel incentives for the edtech industry to collaborate on developing high-quality, evidence-based tools that address education disadvantage.

Educators can help to shape and inform best practice co-design of edtech for the public good (and not just solely for private profit); provide feedback about which tools work best for different purposes and how to limit overuse of these tools in the classroom; and ensure proper teacher professional development in the integration and use of these tools.

The philanthropy sector can direct funding towards initiatives that independently assess and compare edtech interventions according to their proven impact on education disadvantage; invest in Australian-specific and disadvantage-focused edtech for social good; and work on related initiatives that close the digital divide (such as improving digital access and literacy in disadvantaged communities).

Technology developers can build transparent, ethical data controls into edtech across its life cycles; move beyond basic user-testing processes towards co-design with educators; and become more accountable for the impacts (intended and unintended) of their products.

Academics and researchers can generate in-depth, quality research to test assumptions and evidence about the impact of edtech and closely track real-world case studies of its use.

Australian students deserve the best quality edtech, proven to deliver learning progress, aligned with our curriculum standards, and meeting or exceeding expectations for learning outcomes and social equity.

How quality education technology aligns with established factors known to lift outcomes in disadvantaged schools

Legend:
- Link (light blue)
- Strong link (dark blue)

Columns: Intelligent tutoring systems | Smart teaching support tools | Adaptive assessment systems | Early warning systems

School leadership
Factor	Intelligent tutoring systems	Smart teaching support tools	Adaptive assessment systems	Early warning systems
Collective teacher efficacy	Link	Strong link	Strong link	
Developing teacher expertise and skill	Link	Link	Strong link	Link
Organising resources toward the most effective practices	Link	Strong link	Link	Link
Setting clear whole-of-school goals			Link	Link
Monitoring progress on whole-of-school goals			Link	Link
Collaboration between schools				Link

School learning climate and engagement
Factor	Intelligent tutoring systems	Smart teaching support tools	Adaptive assessment systems	Early warning systems
High expectations	Strong link	Strong link		
Early intervention	Link		Link	Strong link
Additional learning time	Strong link	Link		

Attract, develop, and retain quality teachers
Factor	Intelligent tutoring systems	Smart teaching support tools	Adaptive assessment systems	Early warning systems
Reduction of admin burden		Strong link		
Ongoing professional development	Link	Strong link		Link
Teacher reflection and adaption	Link	Link	Link	Link
Quality instructional materials and supports	Link	Strong link		

Effective teaching and learning strategies
Factor	Intelligent tutoring systems	Smart teaching support tools	Adaptive assessment systems	Early warning systems
Explicit instruction	Strong link	Strong link		
Formative assessment	Link	Link	Strong link	
Metacognition	Link	Link		
Data-driven learning and teaching	Strong link	Strong link	Strong link	Strong link
Differentiation/personalisation	Strong link	Strong link	Strong link	

Stronger community connection
Factor	Intelligent tutoring systems	Smart teaching support tools	Adaptive assessment systems	Early warning systems
Timely reporting to parents and carers	Link	Link	Link	Link
Support for parental engagement in learning				
Community and school engagement				Link

An Australian case study:
How quality edtech can have a positive impact on education disadvantage

VICTORIA | Disadvantaged regional secondary school | *Maths Pathway*

School Sector	Year range	ICSEA value	Language background other than English
Government	7-12	966 (30th percentile)	3%

A low-SES regional Victorian high school integrated *Maths Pathway* into their teaching program to better differentiate learning for all students. Previously, the school had created three levels of maths proficiency per year group. The head Maths teacher found that this three-tier approach had worked for most students, but failed to meet the needs of students at the very top and bottom of each cohort. Based on the experience of a nearby school whose student results improved with Maths Pathway, the school decided to deploy the program in 2020.

Technology

Maths Pathway is an adaptive learning tool and smart curricula system for Years K-10. It is used by over 300 schools and 3,774 teachers in Australia. The platform is aligned with the Australian national curriculum and all state curricula.

The Years 5-10 platform combines teacher-led instruction and support with student-led personalised learning to make differentiation achievable for teachers in classrooms where students are at varying levels.

A *Maths Pathway* classroom revolves around a two-week cycle. Students take a diagnostic test on the online platform, which forms an individualised learning path. This path adapts to their Zone of Proximal Development, and provides fully worked solutions and instructional videos. Detailed data from fortnightly formative assessments gives teachers an opportunity to provide one-to-one feedback, address concerns, and set goals with students. The real-time data from assessments and personalised online learning helps teachers cluster students with similar needs, and to conduct small group remediation lessons. Lesson plans are provided, alongside resources for problem-solving tasks.

The Victorian high school uses *Maths Pathway* for Years 7, 8 and 9 students. Three out of five lessons a week involve Maths Pathway. While students work individually, teachers conduct mini-lessons with smaller groups of students to address common learning gaps identified by the platform. Data 'flags' pop up when specific students are struggling with a task. The school has also arranged extra teaching support staff to join each class for one lesson per week.

Impact

The school performed a cross-analysis of the year groups using *Maths Pathway* in comparison with those who weren't using it, and found growth in learning outcomes was higher in the classrooms using Maths Pathway, including for students from low-SES backgrounds.

The head Maths teacher at the school has noted that the program had a considerable impact on students previously struggling to meet grade level expectations. In the past, students in Years 7 or 8 at the school were performing at a Year 2 level, and had become completely disengaged. Teachers observed these students subsequently showed education gains in Maths when using the program. Teachers could

use the tool to take these struggling students right back to foundational maths concepts and build their confidence, with demonstrated positive outcomes.

The Maths department at the school has emphasised the importance of utilising the whole program, not just the individual pathway components. *Maths Pathway* lessons, mini-lessons, whole class written learning, games and one-to-one interventions helped students of varying abilities master modules and stay motivated.

Maths Pathways conducted their own impact analysis across schools, which indicated stronger average growth rates in those classrooms using their product (see Figure 1).
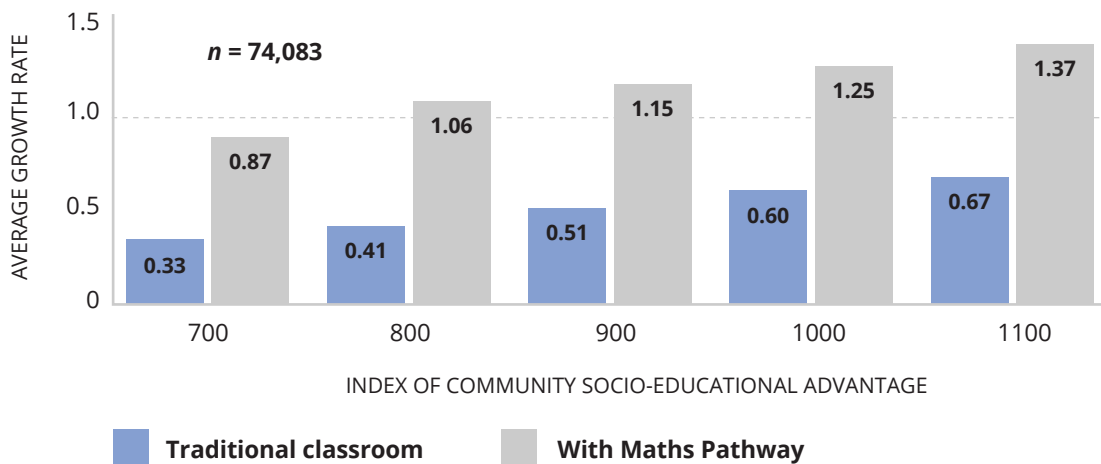

Figure 1: School improvement by ICSEA level – Maths Pathway impact report (2021). NOTE: the products included as examples are not intended as endorsements.

The Author acknowledges Ceridwen Dovey with sincere thanks, for her input and contribution to shaping this introduction.

Access both this introduction, and the full report, online at **uts.edu.au/LeslieLoble**

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15