AVID Myer Mathematics Trial

Finding and sharing the passion, joy and beauty of primary school mathematics

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SIDNEY MYER FUND

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About AVID

(Advancement Via Individual Determination)

AVID stands for Advancement Via Individual Determination. Originating in the United States in 1980, it is a whole-school professional learning system that supports teachers and school leaders to close gaps in students' educational opportunities and achievements. AVID's journey in Australia began in 2011, when The Victoria Institute for Education, Diversity and Lifelong Learning (Victoria University) received Commonwealth funding to trial and research program implementation in Australia. The trial proved successful and in 2015 AVID Center (USA) issued AVID Australia with an exclusive site license for Australia. Today, AVID is being implemented in nearly 60 sites across Australia, equipping several thousand students and teachers with AVID's high engagement learning strategies every year.

AVID supports schools to improve the quality of teaching and learning by:

- Equipping students with the academic behaviours and social and emotional (SEL) skills that will enable them to succeed at school and beyond
- Supporting teachers to become facilitators of learning in a student-centred classroom
- Supporting principals to foster an inclusive and high performing teaching and learning culture at their school.

Acknowledgements

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About the AVID Myer Mathematics trial

Responding to concerns about engagement and success in mathematics among primary school students, the *AVID Myer Mathematics trial* was commissioned by the Sidney Myer Fund and Myer Foundation. It was based on the following theory of change:

IF
we increase confidence, competence, engagement and the self-efficacy of primary school teachers in teaching mathematics

BY
providing ongoing professional learning and by the coaching of content knowledge and pedagogical content knowledge

THEN
students will engage and succeed in mathematics.

Six Australian primary schools and one secondary school from three states participated in a program of specialised mathematical coaching and customised professional learning delivered by AVID Australia between 2018 and 2021. During this period, the participating schools all implemented the AVID system of school improvement. Along with project funding from the Sidney Myer Fund, schools contributed funding towards their participation in the project.

Photo supplied by participating school

What if...

Teaching and learning mathematics in primary school was fun for everyone involved?

Mathematical dialogue was the norm for teachers and students?

The passion, joy and beauty of maths could be experienced by teachers and students?

Photo supplied by participating school

What participation involved

Participating schools were provided with:

- Funding for a part-time, dedicated mathematics coach in each school for 2.5 years
- A customisable program of professional learning and ongoing connection through a professional learning community for the school mathematics coaches
- Specialist professional learning activities for teachers facilitated by experts from AVID USA and Australia
- Coaching for the school mathematics coaches to customise their program of professional learning
- Two in-person steering group meetings for trial school principals
- On-demand, customised professional learning and resources for teachers.

Under the mentorship of the expert coaches from AVID USA and Australia, teachers implemented an agreed repertoire of instructional strategies focusing on five key areas that participants dubbed the 'non-negotiables':

1. Choral counting
2. Sentence frames to promote mathematical discourse
3. Money
4. Mental mathematics
5. Fractions.

These *non-negotiables* reflected consensus among the AVID mathematics experts and Australian school mathematics coaches about areas of mathematical learning that commonly present challenges for primary school students.

Researchers from Victoria University ran surveys about teacher confidence and competence in teaching mathematics and reported results to participating schools during the project. Schools were encouraged to use this information alongside the data that they routinely use to assess students' engagement and outcomes, such as NAPLAN, in-class assessments and student attitude to school surveys.

Project evaluation

Seven government schools participated in the project. These included primary schools from Victoria, NSW and WA and one secondary school in NSW that wanted to ensure secondary teachers were better prepared to meet transitioning students' mathematical needs.

Twenty-seven participants from five schools in Victoria (n=2) and NSW (n=3) contributed to formal evaluation of the project between 2018 and 2022. Participants included five principals and five mathematics coaches. Fourteen participants, including three principals and three mathematics coaches, participated in a second round of interviews in 2021 and 2022 as described below. The WA primary school was not part of formal evaluation, but commissioned an independent evaluation by the researchers.

Researchers from Victoria University and AVID Australia conducted the evaluation with ethics approval from Victoria University and the Victorian and NSW Education Departments. Due to the impacts of the COVID-19 pandemic, the Victorian Department of Education and Training suspended research in government schools at different times during 2020 and 2021. In 2022 the Victorian Department of Education and Training granted the researchers an exemption to enable completion of data collection based on evidence of support provided by the schools.

Evaluation was designed to investigate whether professional learning and coaching had an impact on:

1. teachers' confidence in teaching mathematics;
2. teachers' competence in teaching mathematics, including content and pedagogical content knowledge; and
3. students' learning of mathematics and attitudes to school.

Data that informed evaluation

The project was originally planned for implementation over 2.5 years, from 2018 to 2020. The onset of the COVID-19 pandemic, early in 2020, affected schools' engagement in the project in different ways. In consultation with participating schools and project funder, the formal duration of the project was extended to the end of 2022. Final project evaluation drew on the following sources of data:

Teacher survey

The validated Self-efficacy for Teaching Mathematics Instrument (SETMI) (McGee & Wang, 2014) was used to measure teachers' self-reported confidence and competence. Staff completed the survey at the end of 2018 prior to engaging in any professional learning or activities specific to the program, providing baseline data. They again completed the survey in 2019. The final survey was planned for 2020 but was unable to be undertaken due to COVID-19. In 2022 a very small number of schools participated in the survey. We therefore present only data from 2018 and 2019 below in relation to teachers' reported increases in their own mathematical confidence and that of their students. All schools participated in the surveys in both years. Response rates were high with 81% of eligible staff completing the survey in 2018 and 78% in 2019.

Coaches, journals

Mathematics coaches were invited to keep journals during the project as running records of goal setting and activities. An optional template for this was developed and refined during the project. All five coaches completed journals in 2019 and one coach also kept a journal during 2021.

Semi-structured interviews

Principals, coaches and teachers participated in interviews between 2019 and 2022. These focused on participants' roles and experiences of coaching and professional learning, impacts on teaching practices, school culture and attitudes to mathematics, student learning, and parents' and students' expectations.

In 2019 participants (n=27) were interviewed individually. In 2021 and 2022 (n=15) interviews were facilitated at three schools in groups to build collective insights, alongside individual interviews with school coaches (n=4).

Other sources of data

We invited participating schools to provide examples of de-identified student work with annotations or commentary to show how the project had been implemented and to evidence student learning outcomes. Two schools provided work samples and one school coach provided audio commentary about the significance of the work samples. These work samples are being collated into a digital repository available at avidaustralia.edu.au/myermathematics

What participants told us

1.

Periods of COVID-19 lockdown differentially impacted project implementation, emphasising the importance of customisability to context.

2.

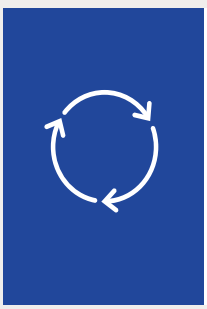
Effective coaching practices were multi-layered, distributed and based on building and maintaining relationships of trust.

3.

Teachers reported increases in their own mathematical confidence and in their students' mathematical confidence.

4.

Allocating funding for the coach's time release and recognition of the coaching role was essential for fostering changes in teaching practice.



5.

Sustainability of project outcomes depended on embedding effective practice, strategic alignment and committed school leadership.

1. COVID 19 lockdowns differentially impacted project implementation, emphasising the importance of customisability to context

COVID-19 led to the secondary school withdrawing from the project. As noted earlier, the WA primary school was not part of formal evaluation. Three schools continued to implement the project after the onset of the COVID-19 pandemic early in 2020. The other two schools did not actively continue with the project in the same way and did not participate in formal evaluation after 2019. The three schools that completed the project and its evaluation reported very different experiences of coaching, professional learning and the extent that they used the project's *non-negotiable* instructional strategies throughout periods of lockdown.

The importance of customisability to context

Teachers from two schools told us how their mathematics coaches continued to be active in leading the learning and teaching of mathematics until 2021. A principal shared how the mathematics coach facilitated school-wide professional learning online that set teachers up to deliver a new syllabus (School 6, group interview, 2022), while a teacher commented:

> **[W]e're so lucky to have [coach] though. Because in COVID when we were in lockdown, [coach] put on a PL like every single Thursday and it made maths so fun.**

So the thought of fractions and teaching fractions in Year Three, Four, Five and Six is a terrifying concept. But she just broke it down [...] our data's improved from it [...] getting these bunch of kindergartens and Year Ones now, I've seen the pattern of what we've taught last year through COVID.

(School 6, group interview, 2022)

One coach had focused on planning as the context for coaching and professional learning at her school (Participant 5 interviews 2019 and 2021). She reflected how weekly planning had influenced teaching practice through differentiated units of work to meet students' needs (School 1, participant 5 journal 2021) and told us how she set one content area for the whole school during lockdowns:

[S]imilarly to how I scaffold for my staff I was putting that into play for our parents, and so if we're doing length and your grade foundation and your 1/2 are very similar and they can do something together, but the expectation was [...] building that family connectedness [...] the older kids could also be helping the younger kids. Activities that we've done when that child was in foundation is still relevant now, so they would have had experience with that.

(School 1, participant 5 interview, 2021)

A colleague affirmed the benefits of this approach:

COVID helped us look at how we plan in maths during lockdown [...] We've changed what we were going to plan and we've looked at things that we know and we've built our parent confidence, which also has that extra layer with our staff and with our students.

(School 1, participant 16 group interview, 2021)

Similarly, after the project had concluded a colleague reported that focusing on planning had helped her to stay conscious of the purpose of her practice and remember to teach explicitly (School 1, participant 34 interview, 2021). This school's focus connects with recent research which found that authentic tasks such as planning are important for effective coaching and cited previous evidence that planning is critical for developing teaching practices that lead to student-centred learning. (Stein et al., 2022)

At another school, the mathematics coach reported that coaching and professional learning tapered after the onset of the pandemic because her workshop-style professional learning did not translate well online and teachers 'really just wanted to be with their kids and really establish those connections again […] Even though I was just coming in to help.' (School 2, participant 12 interview, 2022)

The importance of school context is also explored below in a separate finding about effective mathematics coaching practices.

From 2020 use of the 'non-negotiable' instructional strategies varied

The term *non-negotiables* was coined to refer to the foundational foci and instructional strategies agreed to at the beginning of the project. There was variation in the extent to which participants viewed those strategies as being customisable. In 2019 a principal commented that:

> *The non-negotiables are very well taken up and they are just non-negotiables and they have to do it. Every teacher has implemented these across the school and […] this has had an impact.*
>
> (School 2, participant 17 interview, 2019)

Interestingly, a teacher at that school spoke about the need to 'make those adjustments depending on how their cohort is going'. (School 2, participant 21 interview, 2019) Likewise, the principal of another school recognised the need for customisability, commenting that teachers at his school 'had to be told' that they should use strategies 'around what their class needs' because some had 'felt pressured' to use all of the instructional strategies daily. (School 4, participant 33 interview, 2019) A teacher at another school that did not continue with the project commented that she would have liked a broader range of strategies, as students had become overly familiar with the *non-negotiables* (School 3, participant 26 interview, 2019).

In contrast, staff from two schools reported on the continuing value of the 'non-negotiable' strategies during periods of lockdown. A coach told us how those strategies helped teachers to adapt lessons for home learning:

> *[B]ecause we do a lot of dialogue and we do a lot of concrete learning, teachers were able to put that into their plans […] for home […] to implement some of the lessons that they were doing in school […] If they told students […] "Okay, this is what I want you to do. I want you to have a three-column note page," students would know […] the first one would be a model. Your second one would be your explanation. Your third one would be […] your example. So things like that actually made it easier because they already had the organisation set up.*
>
> (School 6, participant 6 interview, 2022)

Similarly another coach reported on colleagues' improved understanding of mathematical strategies and their ability to engage parents during lockdowns. (School 1, participant 5 journal, 2021) A colleague affirmed that:

> *We've got really good examples through these activities and this approach […] in the first lockdown, I ended up doing several videos […] specifically for the parents and I used almost word-for-word the stuff from AVID to explain it to them. This is what we're doing and why.*
>
> (School 1, group interview, 2021)

Notably, another teacher from that school commented that:

> **[W]e get huge engagement in our maths online […] quite often kids used to go "Oh, not maths", and now it's "Yes, we're doing maths". It's just a shift in thinking and that's translated online quite well.**
>
> (School 1, group interview, 2021)

Teachers at another school told us that moving online limited the extent to which instructional strategies were implemented, as the principal explained:

> *[T]he stop-start nature of COVID has been another big factor [...] you just get sort of in the flow and then you're out again [...] That's been really, really tricky and, like most teachers have said, they really can't do the non-negotiable stuff that's required in remote learning; it's not really working that well [...] some students engage, but not all of them.*
>
> (School 2, group interview 2021)

Despite this, a teacher at that school also reported how instructional strategies had continued to influence teaching practice around differentiated mathematical challenges: 'to make it more interesting to the children, and to have that positive talk, like, "You're going to achieve this," at different levels so that every child can at least complete one challenge. (School 2, participant 10, group interview, 2021)

Teachers also mentioned ways that they adapted and extended the original strategies to keep building teachers' and students' mathematical confidence and capabilities. One teacher talked about asking the school mathematics coach for guidance on using number talks as a 'next step' that led to 'very rich' conversations with students. (School 2, group interview, 2022) The school's mathematical coach explained the value of this:

> *[O]ur better mathematicians were good at the process, but they didn't actually really understand what they were doing. So, we decided to [...] expand it [mental maths] into lots of number talks and really sharing their thinking and how they've worked it out and recording that and going, "Ooh, who saw a different way?" and really validating, there's really not just one way to work things out. He saw a different way, okay, and then we can get into the discussions, "Okay, well, which one's the more efficient way? Yes, you might have got the answer, but if you had to do 10 steps and somebody only did two, which one's going to be quicker or which one will be more likely to make mistakes on if there's so many steps?*
>
> (School 2, participant 12 interview, 2022)

Reflecting a changed perspective from 2019, the principal endorsed this customisability, commenting:

> **[T]he non-negotiables have morphed, and particularly this year, even more so than ever, there's just been more flexibility given to our teachers to make a professional judgement of how they get them into their lessons.**
>
> (School 2, group interview, 2022)

Similarly a coach reflected on how she had extended instructional strategies; for example, building on choral counting in early years to elicit conversations with students about number patterns. (School 6, participant 6 interview, 2022) She told us how this customisation was endorsed by the USA AVID expert coach when she showed him a video demonstrating extension of choral counting, commenting:

> *So that was fantastic to be able to take something that [...] we'd been given and then go, "Okay, how can we transform this so that it's even more meaningful for teaching, and even more meaningful for our students"?*
>
> (School 6, participant 6 interview, 2022)

Taken together, participants' accounts link to existing research on effective professional learning and school improvement by emphasising the importance of ongoing learning that is customised to school context, involves collective participation across year levels and ongoing reflective conversations (Desimone & Garet, 2015; Lee & Lewis, 2019).

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2. Effective coaching practices were multi-layered, distributed and based on relationships of trust

Participants reported a variety of coaching practices, including group professional learning with integrated resources, peer observation, modelling of practice and one-on-one mentoring. These practices varied across schools and changed over time. However, from early in the project, accounts mentioned multiple layers, distributed responsibilities, and building and maintaining relationships of trust as being effective in their different school contexts.

Multiple layers of coaching and professional learning

In 2019 a principal shared how coaching at her school involved mentoring by an external expert (AVID USA), supported by focused planning with the school mathematics coach who worked with a team of five teachers located across year levels. (School 1, participant 15 interview, 2019) Similarly another principal mentioned having systems for sharing practice across the school and within teams. (School 2, participant 17 interview, 2019)

Reflecting on the approach taken at her school, a member of the leadership team commented:

> *[T]hat's a good word to use, 'layers' because I think that each added an element. As [participant 11] said, when he was talking about the external approach, he came in with this absolute, I love maths [...], which [school coach] also has, but sometimes it's really good to have that different person come in and share this love and he put that little fire under everybody. It's almost like [school coach] and [AVID USA expert coach] were working in unison [...] And then, of course, you've got people like [participant 20] and [participant 11] who are working with [school coach], then that's that other layer again, going into the classroom and [school coach] planning.*
>
> (School 1, participant 16 group interview, 2021)

This multi-layered approach connects with previous research on effective instructional coaching which recognises coaching as part of broader professional learning that is context-specific and sustained over time. (Kraft et al., 2018)

Teacher goal-setting was also identified as an effective practice, with one teacher (School 1, participant 34 interview, 2021) and one coach (School 2, participant 12 interview, 2022) telling us that teachers set goals around the *non-negotiables* as part of the coaching process. Again, this focus on teacher goal-setting aligns with previous research on effective instructional coaching practices. (Gibbons, Kazemi, & Lewis, 2017; Knight, 2019; Stein et al., 2022)

Integrated resources formed another layer of practices reported by staff from the three schools that completed the project. A teacher told us:

> *[W]e've been lucky is with resources. It's one thing to be able to be given all this PL and say use this and use that. If we didn't have the physical resources and someone to go here, here's a beautiful present, use it, we wouldn't [..]. [Coach]'s spent so much time giving us resource packs, so we just take it and can have success. I think a lot of the time with teaching, it's too hard if you have to go and source it yourself because you just don't have the time.*
>
> (School 6, participant 37 group interview, 2022)

Similarly, a member of the coaching team at another school commented:

> *[I]t's very easy when we get overwhelmed to, you know, leave some things out or things like that. But referring to them, putting them explicitly into planning documents to make sure that they are being referred to. We've created posters and things, classroom displays [...] to really keep it at the forefront.*
>
> (School 1, participant 34 interview, 2021)

Taking a slightly different approach, another coach told us she had created a website for colleagues to support mathematical planning. (School 2, participant 12 interview, 2022)

Distribution of responsibility

Staff mentioned the distribution of responsibility as an effective practice. Teachers from one school spoke about a 'gradual release of responsibility' achieved through targeted planning, with one teacher telling us how a team of coaches from different year levels had allowed the school mathematics coach to 'take that little step back.' (School 1, participant 16, group interview 2021)

At another school teachers spoke about a distributed model of professional learning and modelling of strategies that was implemented across the school by three teachers. (School 6, group interview, 2022) The school's principal commented:

> **So there's things coming from the bottom-up and from the sides-in, as well as the leaders, the people who are driving these programs have also got the capacity to look, to self-reflect on themselves as ongoing learners as well.**
>
> (School 6, participant 9 group interview 2022)

Collaboration and reflective practice were also evident in the way that coaches spoke about their roles. In 2019, one coach distinguished her role of 'coach' from that of a 'mentor' by explaining that she worked collaboratively with colleagues to solve problems and support them to find answers themselves. (School 2, participant 12 interview, 2019) Interestingly, at that stage the principal at her school referred to that coach as being a 'mentor' to other staff. (School 2, participant 17 interview, 2019) This suggests that ways of working were more important at that school than the terminology used to describe them.

After the project, a coach spoke about how she had been learning alongside her colleagues. Most notably she shared how she had taken up the opportunity to teach a unit in first year university mathematics, recounting that she sometimes needed to 'teach myself [...] in order then to teach them.' (School 1, participant 5 interview, 2021) Reflecting on this experience, the coach commented that it gave her insight into gaps in primary school mathematics education, specifically work around prisms and 3D objects. She reported that:

> *[I]n grade 5/6 particularly this year we spent [...] probably six weeks on geometry and going all the way back to 2D and linking it to 3D and the prisms and really hands-on stuff. It's come through in our NAPLAN results that we achieved higher on those questions than any others. So it's shown me that those theories that I put into practice have worked, and I'm actually really excited and happy about that.*
>
> (School 1, participant 5 interview, 2021)

Similarly, another coach commented that responding to colleagues' needs sometimes involved trialling new practices for the first time herself. (School 6, participant 6 interview, 2022) Together, these coaches' accounts of their roles align with evidence about effective coaching practice in emphasising partnership, a focus on instructional strategies, working with individuals and groups, and reciprocal learning between coach and teacher. (Devine et al., 2013; Galluci et al. 2010; Knight, 2019)

Although coaches described their roles as collaborative, teachers from four schools spoke about the coach as an expert guide. (School 1 principal participant 15; participants 16, 20; School 3 participant 24; School 6 participant 3 interviews, 2019) More recently, one teacher described her school's coach as 'the driving force here [who] provided the resources that we needed, demonstrated the things we need to be doing.' (School 6, participant 36 group interview 2022) Across different accounts of coaching during the project, it became clear that for coaches to be both expert guide and collaborator they had to build and maintain collegial relationships based on trust.

The need to build and maintain relationships based on trust

At the beginning of the project, all coaches undertook some observations of colleagues' teaching practices, but experiences of peer observations varied by school and over time. A principal spoke about a decision to move the coaching focus from peer observation to mentoring through review of work samples and classroom practice to enable more targeted feedback. (School 3, participant 22 interview, 2019) Teachers at another school expressed different perspectives on peer observations. One teacher queried the frequency based on other strategies also underway at the time (School 2, participant 10 interview, 2019) and the coach also noted that the frequency of observations had been challenging. (School 2, participant 12 interview, 2019) Other teachers commented on the value of the coach's observations. (School 2, principal participant 17; participants 8 and 21 interviews, 2019) A coach and teachers from a different school reported that peer observations were needs-based (School 4, participants 9, 29 interviews, 2019) while a different coach commented that she wasn't doing many classroom observations because staff weren't ready for that yet. (School 6, participant 6 interview, 2019)

In 2019 a teacher spoke about colleagues' perceptions that modelling of practice was more valuable than peer observation. (School 1, participant 11 interview, 2019) At that time, other staff also spoke about the value of modelling practice, including principals (School 2, participant 17 interviews, 2019), colleagues (School 2 participant 8; School 4 participant 29; School 6 participant 13 interviews, 2019) and coaches themselves (School 4 participant 14 interview, 2019; School 2 participant 12; School 6 participant 6 interviews, 2022).

After the project, participants noted the importance of taking time to build openness and trust as the basis for effective coaching. One mathematics coach reflected on the value of planning as the vehicle for coaching. She commented that this approach meant teachers did not necessarily realise that they were being coached and noted that related resources, which included professional readings, formed the basis for 'really rich' professional conversations with teachers. (School 1, participant 5 interview, 2021) A colleague spoke enthusiastically about the journey of a long-time teacher at the school who had learned to:

> *sit and listen and reach out and say, look, I don't get it. There's been a lot of work putting in to get this particular staff member to show their vulnerability [...] it's been really great to see this person's journey.*
>
> (School 1, participant 34 interview, 2021)

Likewise, the coach observed the importance of facilitating 'targeted professional learning in an unthreatening way to allow teachers to be vulnerable and honest about their learning needs'. (School 1, participant 5 interview, 2021) This was separately affirmed by a colleague who recounted a shift in culture from a perception that modelling instructional strategies 'was almost like a bit of an invasion in the class. The teachers, feeling a bit like they were being judged too, now welcoming it and looking forward to that time.' (School 1, participant 11, group interview 2021) Similarly a principal at a different school mentioned that 'our staff are really great at having people come into their classes, and open to get feedback and so on, to improve their practice.' (School 2, group interview 2021) Similarly, at another school a teacher also observed that:

> **Having someone like [coach] or someone else come in with a little bit more experience [saying], "Have you tried this, have you tried that?" That makes a positive culture. That makes us feel okay. We don't know everything, neither do they. Let's all work together. How can we make sure that we're just supporting the kids?**
>
> (School 6, group interview 2021)

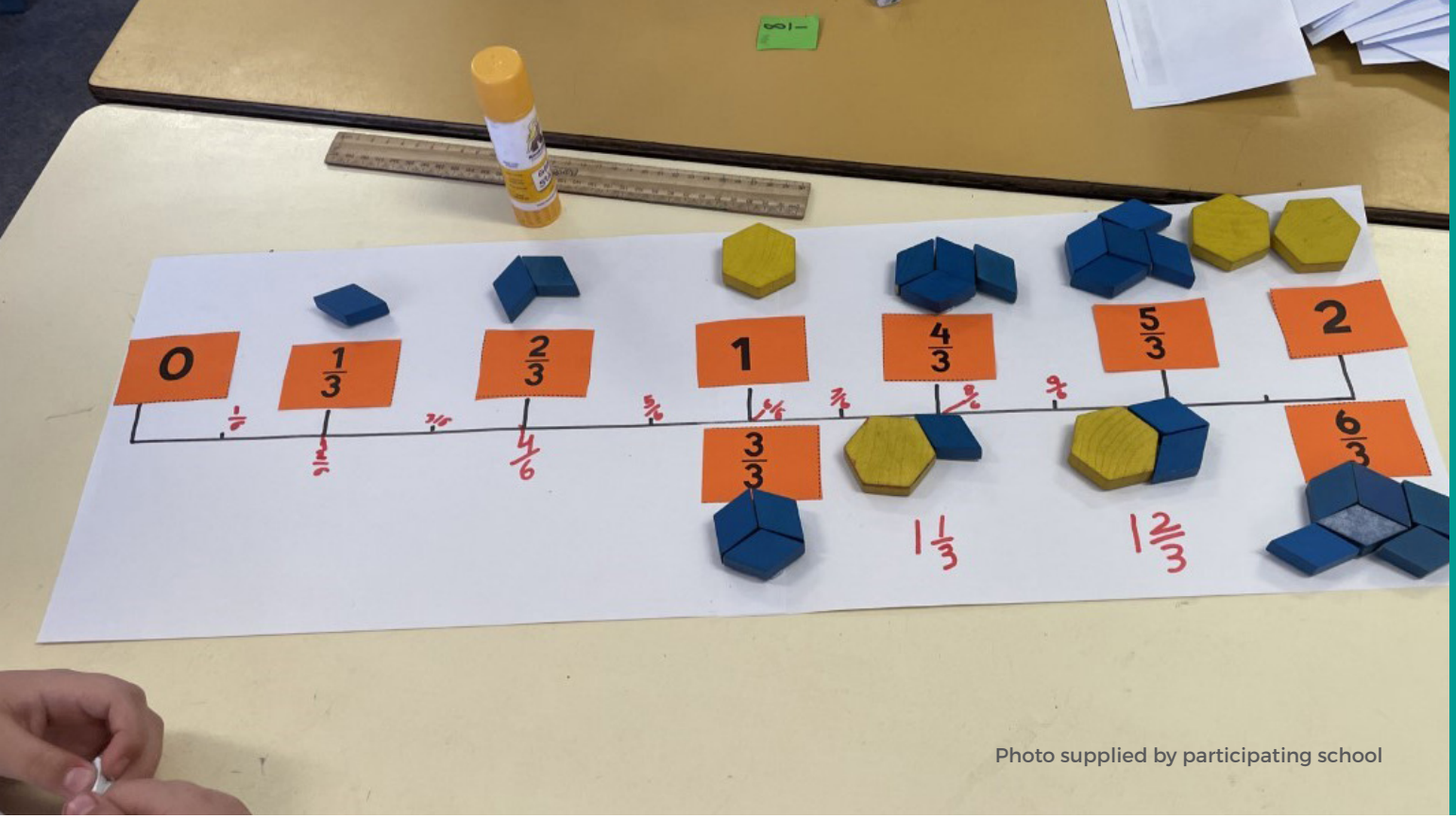


Photo supplied by participating school

This emphasis on collective capacity building grounded in relationships of trust connects with previous research on effective instructional coaching practices (Brown, Harrell, & Browning, 2017; Jao, 2013) and the importance of a supportive school culture as a context for these. (Gibbons, Kazemi, & Lewis, 2017) The role of school culture in project experiences and outcomes is considered further below in a separate finding about reported changes in teachers' and students' mathematical confidence during the project.

Scaffolding the coaching role

Different accounts of coaching experiences and practices suggest the importance of ongoing communication to guide implementation, and ongoing professional learning to scaffold the coaching role.

In 2019, a school principal talked about the need to coordinate with other schools in their area about 'how to move on together as a group.' (School 4, Participant 33 principal interview, 2019) Participants from another school expressed a need for connection around progress (School 3, participant 32, coach), support and resources (School 3, participant 22, principal) along with clarity about expectations. (School 3, participants 24 and 30) Interestingly, that school's coach noted the value of networking with other coaches and principals which led to visits to two other schools involved in the project. (School 3, participant 32 interview, 2019) In contrast, a coach at a different school talked about feeling isolated despite being in contact with another similar school and sharing practices. She remarked that:

> *[Y]ou are really an island as a coach but you really are the island within the school and collegiate support is quite abstract.*
>
> (School 2, participant 12 interview 2019)

These reflections indicate that coaches' perceptions and experiences might not necessarily accord with their colleagues' and suggests a need for coaches to have ongoing professional learning and coaching irrespective of school culture. This connects with previous research that found variable outcomes of coaching are dependent on coach training and support (Russell et al., 2020) and evidence from other research that instructional coaches learn effective coaching practices over time (Stein et al., 2022).

3. Teachers reported increases in their mathematical confidence and their students' mathematical confidence

One of the goals of the project was to foster discovery of the 'passion, joy and beauty' of primary mathematics among teachers and students alike. Participants told us about changes to school culture and teaching and learning practices that indicated moves towards this outcome during and after the project.

Importance of school culture

Staff mentioned the importance of fostering common beliefs, expectations, language and practice around primary mathematics teaching and learning for effecting improvements in teachers' and students' confidence and capability. This connects with evidence of a relationship between teachers' beliefs and their mathematical teaching practices. (Aslan, 2013; Beswick & Goos, 2012; Ellington, Whitenack, & Edwards. 2017; Grootenboer, 2008; Hughes et al., 2018) It also affirms research about the importance of enculturating effective teaching practice through the coaching process. (Gibbons, Kazemi, & Lewis, 2017)

A principal commented that AVID had contributed to a school culture of 'belief that the kids of disadvantage and high needs can achieve'. (School 1, participant 15 principal interview, 2019) After the project, a member of the school's coaching team commented:

> **I just [...] want to mention again the overall positive impact it's had on our staff and our kids. Maths is no longer daunting to teach or to learn. So I think that's been a huge [...] shift in our culture.**
>
> (School 1, participant 34 interview, 2021)

Similarly, the principal told us that despite staff turnover, teachers' attitudes to mathematics had become more open and they were learning to love it. (School 1, principal, group interview, 2021) A coach from a different school reported that:

> **We've shifted from students "can and can't do maths" to "every student can do maths".**
>
> (School 6, participant 6 interview, 2022)

The principal at her school concurred, mentioning a 'high expectations learning culture' and commenting that 'it's like the enthusiasm for teaching maths and looking at a different way of delivering it has gotten to every nook of the school and everybody is trying to [...] add their part'. (School 6, group interview 2022) Similarly, earlier in the project a teacher from another school referred to high expectations at his school and reported that he was 'more confident in meeting those expectations'. (School 3, participant 30 interview, 2019)

Participants also told us about the importance of having consistent strategies to foster a 'predictable environment so they know what to expect' (School 2, participant 26 interview 2019) and commented on the value of having staff 'on the same page'. (School 3 and school 4 interviews 2019; School 6, participant 3 interview, 2019)

Reflecting on project outcomes, one teacher mentioned that 'it's changed the way I've been teaching and the way the kids are learning'. (School 6, participant 36, group interview, 2022) A colleague affirmed this, stating that she was 'able to be brave enough and try that and see the kids really love it and have really rich conversations, more so than just teacher talk'. (School 6, participant 37 group interview, 2022)

Finding the joy in teaching primary mathematics

Early in the project, teachers associated the use of instructional strategies with greater 'enjoyment' in teaching mathematics. (School 4, participant 19 interview, 2019) One teacher commented that she liked teaching mathematics despite having disliked learning mathematics. (School 1, participant 16 interview, 2019) Another mentioned that focusing on students' enjoyment had made teaching mathematics 'a lot smoother'. (School 3, participant 24 interview, 2019)

After the project, a coach reflected on changes in teachers' confidence in mathematical teaching practice:

> **I actually do think that our staff believes that they can learn in maths because it's planned in such a way that kids love maths and they want to learn and teachers want to teach it.**
>
> (School 1, participant 5 interview, 2021)

Staff also linked use of the strategies with changes in teaching practices. A principal observed that staff had moved away from using worksheets now they had a number of instructional strategies in their 'toolbox' and once they saw students' achievements. (School 1, participant 15 interview, 2019) Similarly, a coach reported that using different instructional strategies had given teachers the insight that many mathematical skills cannot be tested using a textbook or worksheets and that students could make their own mathematical connections. (School 6, participant 6 interview, 2019)

Teachers also commented on the value of the *non-negotiables* for differentiating instruction (School 3 coach participant 32; School 6 participant 13 interviews, 2019). After the project, one mathematics coach reflected that building teachers' capability to differentiate was an important focus during the project. (School 1, participant 5 interview, 2021) She noted a connection between growth in teachers' confidence and their conceptual understanding of mathematical content areas such as addition, subtraction, decimals, fractions, measurement and geometry. (School 1, participant 5 journal, 2021) This connects with research identifying mathematical content knowledge as a basis for knowing how to teach mathematics effectively. (Agathangelou & Charalambous, 2020) Previous research has found that both mathematical content knowledge and knowledge about how to teach mathematics are needed for effective mathematical teaching and learning. (Coe et al., 2014; Dinham, 2014; Jensen et al., 2016)

Another coach also reported changes in teaching practice, including increased use of number talks with students, where she saw 'a lot less worksheets and pen and paper and [...] a lot more hands on and thinking and talking about things'. (School 2, participant 12 interview, 2022) That coach also reflected that this outcome was not attributable to the project alone, but also related to other professional learning, and the direction in which she had led the school.

Teachers made connections between their own mathematical confidence and students'. One teacher commented that teacher enthusiasm spread to students (School 4, participant 29 interview, 2019), while the principal at the same school commented that staff had been reviewing research for some time and 'know that they have an impact and are very careful to not pass on their lack of confidence and to not disadvantage the kids'. (School 4, participant 33 interview, 2019) Another principal remarked that 'there is definitely an increase in the kids' confidence and love of maths and it is directly related to teachers' confidence'. (School 1, participant 15 interview, 2019) After the project, a teacher at that school commented:

> *[T]here is a seismic shift [...] I think, the surveys that we did at the beginning of, where you put it on your comfort scale, for teachers and students, has vastly changed. Probably more in students than teachers, if I'm honest.*
>
> (School 1, participant 11 group interview, 2021)

The school mathematics coach commented:

> **Students and teachers at [School 1] are highly engaged in mathematics. Students' positive attitudes and learning disposition reflect a significant change in the way they see themselves as maths learners.**
>
> (School 1, participant 5 coach journal, 2021)

Together, these teachers' accounts connect with previous research that found a relationship between teachers' attitudes to mathematics and students' attitudes to mathematics. (Aslan, 2013; Eden, Heine, & Jacobs, 2014; Jensen et al., 2016) What participants told us also affirms research evidence that ongoing coaching can be effective in changing and developing mathematical teaching practices. (Campbell & Markus, 2011; 2013; Devine, Houssemand, & Meyers, 2013; Ellington, Whitenack, & Edwards, 2017; Kraft et al., 2018; Russell et al., 2020)

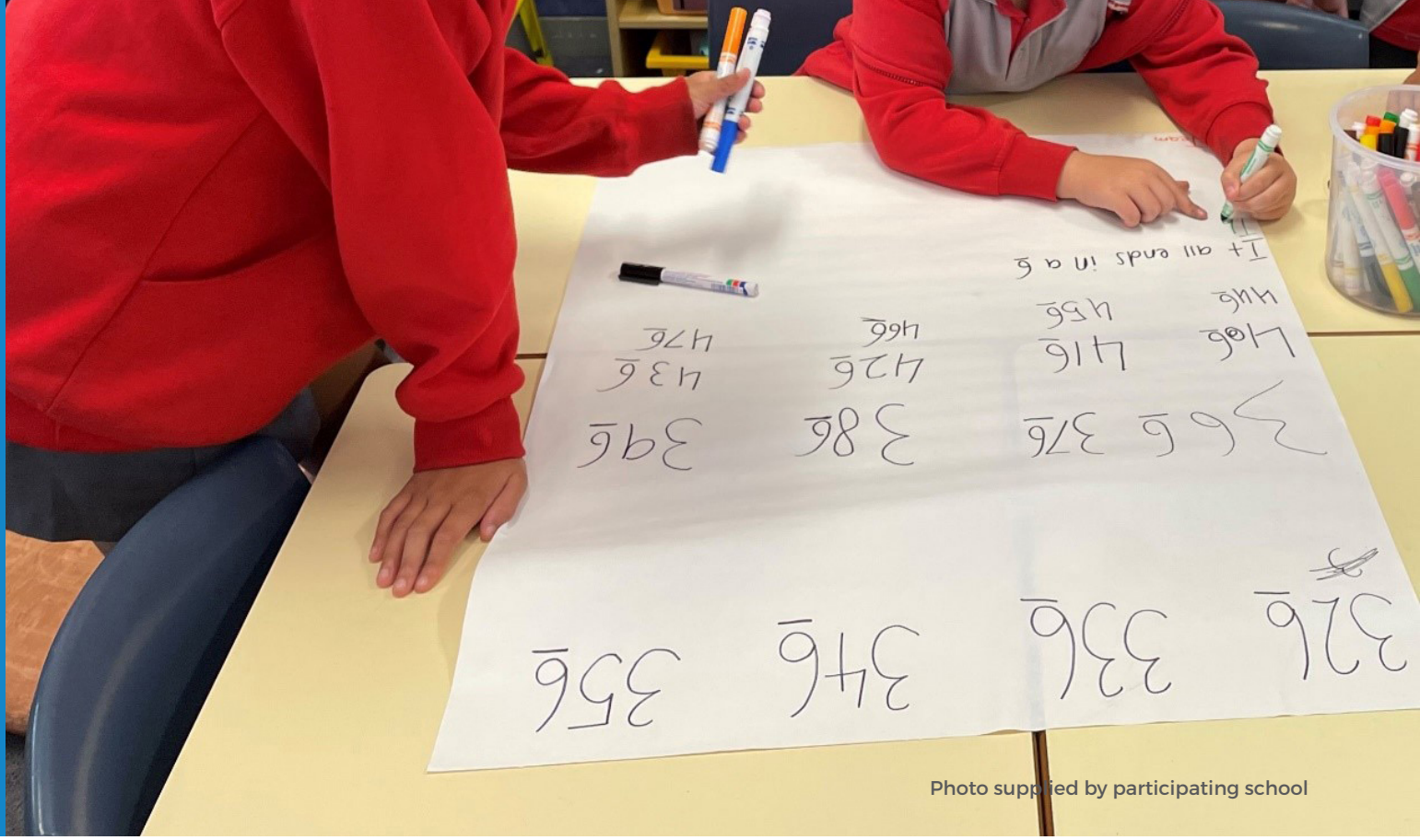


Photo supplied by participating school

Finding the joy in learning mathematics

From 2019, teachers told us that students' enjoyment of mathematics increased. (School 1 participant 20; school 3 participant 26, school 3 coach participant 32 interviews, 2019) They also reported improvements in students' confidence in learning mathematics. (School 1 participant 11; School 3 participant 24; School 4 participants 19, 29 interviews, 2019)

A coach reflected:

> *When I look at [school survey] [...] our kids love maths [...] there's two questions. The first question is where do they plot themselves as a learner – where are you as a maths learner – and they can think themselves right at the bottom, that they're no good at maths, like their one word to describe maths is fun, or whatever it might be. So they might think they're no good at it, but they still love it [...] and I think that translates to our teachers and that's kind of really what I wanted to get out of it. I wanted for them to think that it's not hard, you just have to keep trying.*
>
> (School 1, participant 5 interview, 2021)

At another school, the mathematics coach and teachers also reflected that students' confidence in learning mathematics had grown. (School 6 participant 36 group interview, 2021; school 6 participant 6 interview, 2022)

In telling us about student outcomes from the project, participants from two schools referred to test results as an indicator of improved student outcomes. Such results included progressive assessment testing results (School 1, participant 15 principal interview, 2019) and increases in NAPLAN results on numeracy for Years 3 and 5 since 2017, with school outcomes now exceeding the state average, having previously been below it. (School 6, participant 6 interview, 2022) This connects with prior research which has shown that instructional coaching can demonstrably improve student learning outcomes as well as teaching practices. (Campbell & Markus, 2011; Ellington, Whitenack, & Edwards, 2017; Kraft et al., 2018)

Changes in teachers' self-reported competence and confidence in teaching mathematics (2018-2019)

Figures 1 and 2 show a comparison between self-reported competence and confidence in teaching 15 mathematical concepts. As can be seen from the figures, competence and confidence had improved in 2019 compared to the baseline of 2018. Generally, there were greater improvements in self-reported competence than in confidence. This is possibly because self-reported confidence was already relatively high at baseline (2018). As previously noted, due to COVID-19 impacts, only a very small number of schools participated in the survey in 2022. We therefore present only data from 2018 and 2019.

Figure 1: Teachers' self-reported competence in teaching mathematics, 2018-2019

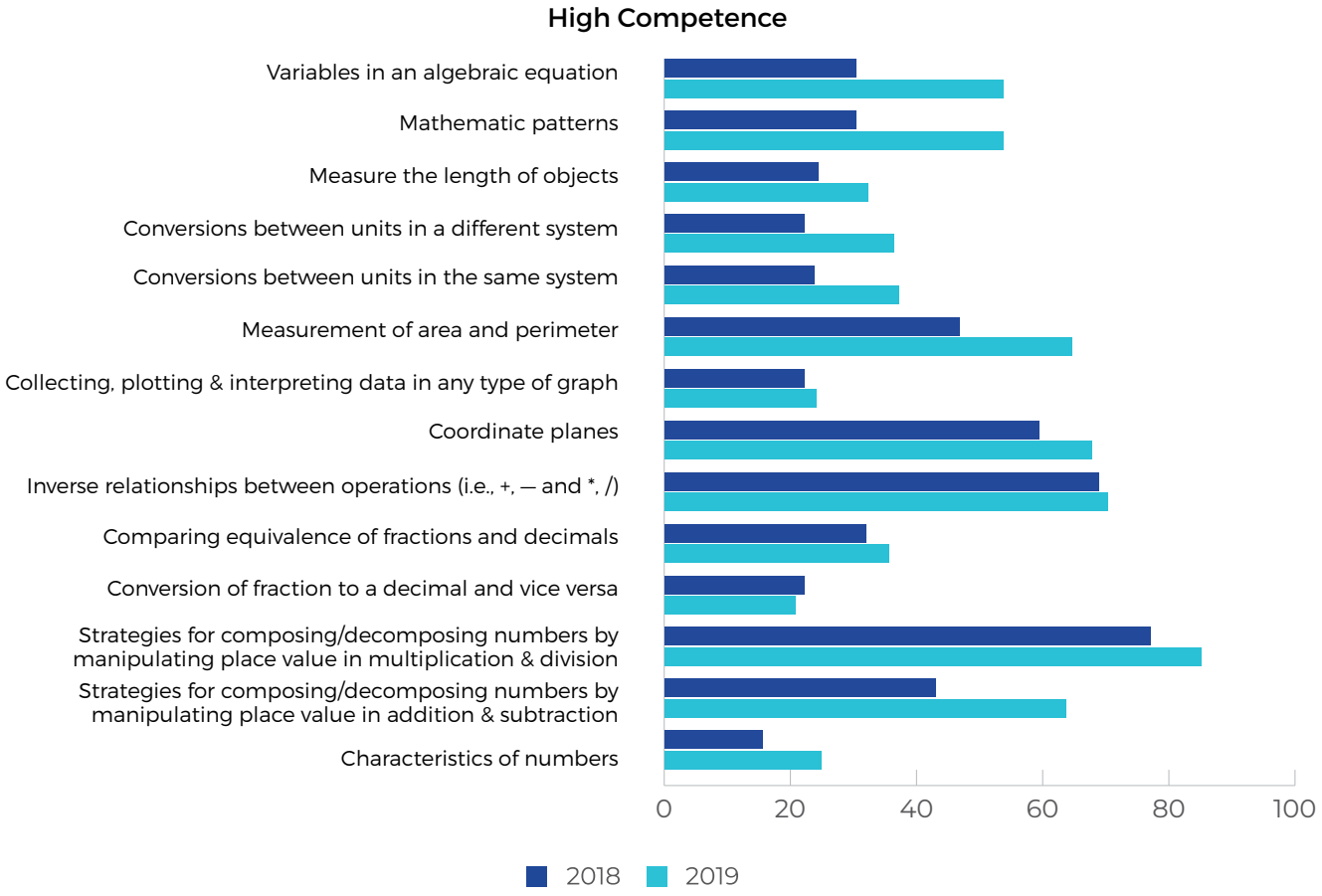
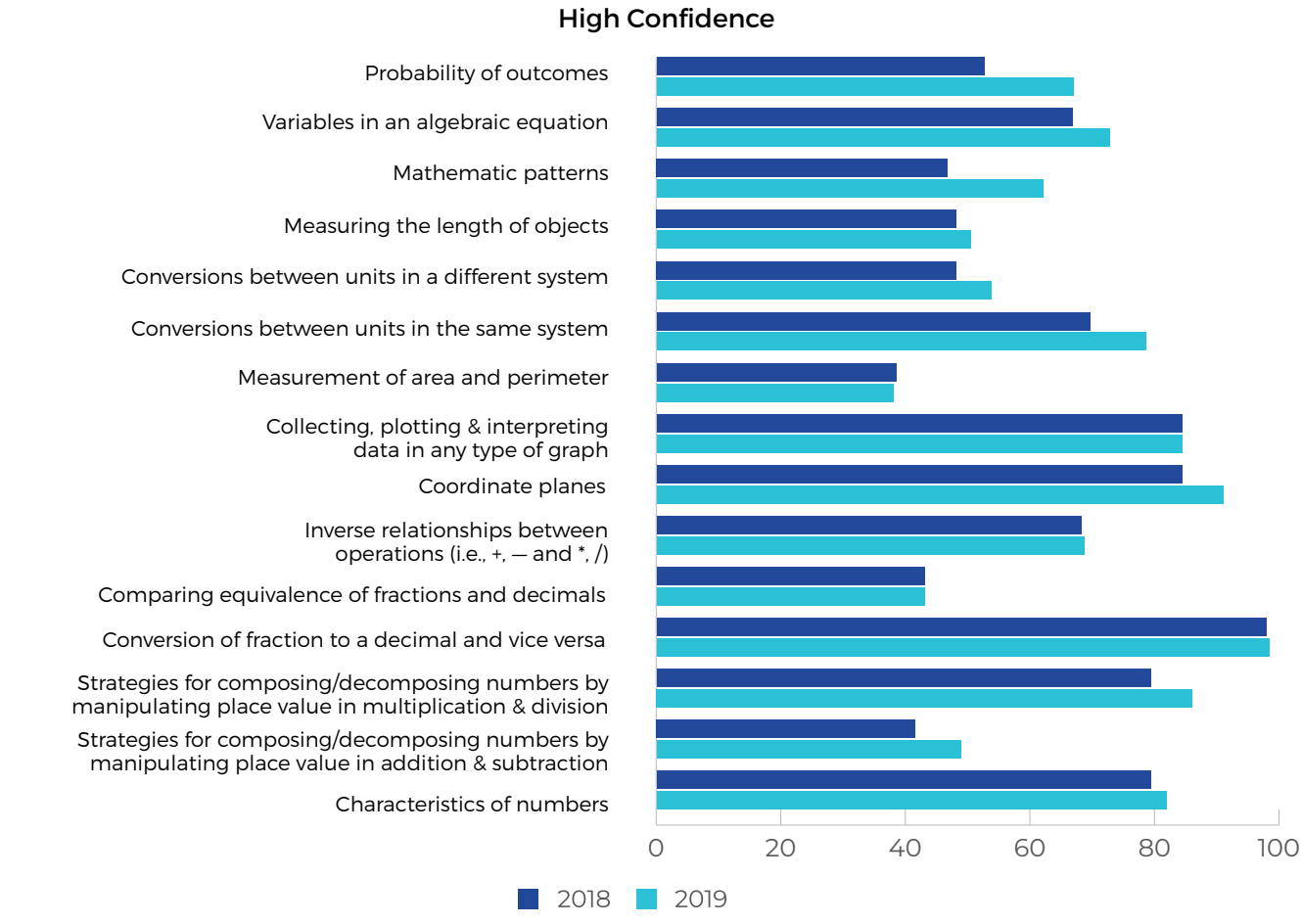


Figure 2: Teachers' self-reported confidence in teaching mathematics, 2018-2019



The importance of academic language

Teachers told us that having a common language for talking about and understanding mathematics was valuable for teachers and learners alike. One mathematics coach commented that students' 'language is consistent and they know the routine and they know how it works and this is from K-6'. (School 4, participant 14, 2019) Her colleagues concurred (School 4, participants 19, 29 interviews, 2019). Teachers also mentioned the importance of academic language use for fostering a positive mathematical culture. At one school, this focus began early in the project, including the language that teachers used in higher-order questioning and that students used to articulate their thinking. (School 2, participants 12, 21 interviews, 2019) After the project, teachers from that school also mentioned the importance of using mathematical language. (School 2, group interview, 2021) The coach from a different school highlighted the importance of 'consistent academic vocabulary' use by both teachers and students (School 1, participant 5 journal, 2021), to set high expectations, linking expectations and student achievement:

> **[W]e've raised those expectations. I think we have really high expectations and that's the culture that comes through in maths. We have high expectations but the kids rise to meet us.**
>
> (School 1, participant 5 interview, 2021)

Similarly, teachers at another school talked about the importance of using consistent academic language in teaching and learning mathematics from the beginning of school. (School 6, group interview, 2022) In this respect, sentence frames, which were one of the *non-negotiables*, were identified as being useful. (School 6 group interview, 2022; School 6 participant 6 interview; School 2 participant 12 interview, 2022)

From 2019, a number of participants reported the increased use of academic language by students as an observable outcome of the project. One school principal noted the consistent use of the strategies across the school and linked this to observable increases in students' use of academic language and thinking. (School 2, participant 17 interview, 2019) Several teachers at that school linked academic language use with improvements in students' problem-solving capability. (School 2, participants 8, 10, 12 and principal interviews, 2019)

Reflecting on student outcomes related to the project, a teacher commented on the increased length and complexity of the sentence frames that students used. Comparing changes in students' capabilities when she taught them in Year One with what they could do in Year Four (which she now teaches), that teacher noted improvements in students' abilities to articulate their thinking alongside a shift from focusing on the answer to focusing on the process for reaching the answer. (School 2, participant 10 group interview, 2021) The school's mathematics coach also reflected:

> *I think the major influence is on their learning, is that they're now understanding that they actually have to understand what they're doing. It's not just a process. It's not just these steps [...] But really having to explain my thinking and why I've done it that way and giving them a chance to reflect on, well, I don't know why I did it that way, that's just the way you do it. So, it's shown possible misconceptions in that we need to make sure that we show the kids not just the process but why it works and giving them the opportunity to find ways that don't work. Well, why doesn't that work and this one does? What's the difference?*
>
> (School 2, participant 12 interview, 2022)

Teachers at another school also reflected on growth in students' ability to 'talk maths' and explain their reasoning, providing examples such as:

> *I did a lesson today looking at making 2D shapes from smaller 2D shapes using packing blocks. And so there was an activity I asked them. They had to make a trapezium out of the three triangles. And so they're manipulating those, tracing around them and making them [...] I modelled it and then showed them how to do it. But I had a group of shapes on the floor for kids who were finishing early [...] and the best part of the lesson was those kids sitting on the floor and playing with them, because they were putting them together and saying, I've got a hexagon here [...] the kids just sitting on the floor and playing had all the language.*
>
> (School 6, participant group interview, 2022)

Similarly, other teachers reported increased learner agency linked to a 'release of responsibility' to the class (School 1, group interview, 2021) and a change in expectations of students:

> **I feel the students understand that they have gone from the expectation is that you provide the correct work, or the correct answer to now the expectation is that you are able to articulate or write down your thinking.**

> *Now they know it's an expectation and they don't get shocked when you ask them to prove it, or to explain it, or to come to the front and say, "How did you solve it out?" [...] I think at the beginning is a bit of a shock, I mean, "What do you mean? The answer is right. Why do I have to explain"?*
>
> (School 2, participant 10 group interview, 2021)

This was echoed by the school mathematics coach (School 2, participant 12 interview, 2022), while another coach commented:

> *[S]omething, for example, like choral counting and looking for patterns; you know, every student can look at that and they would come up with something like, "Oh, you've got ones in the first column." Now, they may not know that that's the tens column. But they can see things like that and they can be more active participants in it whereas [...] with traditional maths, pen and paper, students are looking at [...] a page of numbers and not getting it, and feeling lost. So I think [...] having more of active dialogue in the classroom that AVID strategies brings out is definitely better for their learning.*
>
> (School 6, participant 6 interview, 2022)

These accounts connect with previous research in emphasising the value of dialogic practices and use of academic language for developing mathematical teaching practice (Gibbons, Kazemi, & Lewis, 2017; Russell et al., 2020; Stein et al., 2022) and enhancing students' higher-order thinking skills. (Russell et al., 2020)

Taken together, self-reported experiences of changes in teachers' and students' mathematical confidence and capabilities support the project's theory of change that building teachers' mathematical confidence and capabilities would also build students' mathematical confidence and capabilities.

4. Allocating funding for the coach's time release and recognition of the coaching role was essential for fostering changes in teaching practice.

Schools contributed funding alongside philanthropic support to enable their participation in the project. However, during the project they reported different capacities to fund their involvement. Despite expressing commitment to the project long-term and noting the importance of having his team on board, the principal at one of the two schools that did not continue with the project until 2021 raised concerns about costs associated with implementation. (School 4, participant 33 interview, 2019)

Staff at all the participating schools told us ways that finding time for coaching, implementation of new strategies and professional learning presented challenges to project implementation. Early on, a principal mentioned difficulties in finding staff to cover for the school mathematics coach (School 3, participant 22 interview, 2019), and a teacher at that school noted that 'time is a challenge to try different things and to work it out'. (School 3, participant 24 interview, 2019) Similarly, a colleague noted some reluctance to take on strategies because 'there is always other stuff going on'. (School 3, participant 30 interview, 2019) A coach from a different school observed that, 'the challenge is getting everything into the lesson with the timetable but the kids are so engaged and this makes it a bit easier to do'. (School 4 participant 14 interview 2019) This sentiment was shared by staff from the three schools that continued with the project from 2020. One principal commented that, 'it is difficult to find the time to fit everyone in' (School 2, participant 17 interview, 2019), while a teacher at that school mentioned having 'too much to teach and you have to teach it too quickly [...] kids are not grasping the concepts, which they probably could'. (School 2, participant 3 interview, 2019) Similarly, a mathematical coach noted that finding time for professional learning was a challenge. (School 6, participant 6 interview, 2019)

Staff from schools that continued with the project through to 2021 expressed a longer-term view about the time needed to foster change. One coach noted the importance of considering teacher workload in facilitating change (School 1, coach participant 5 interview 2021), while another coach reflected that:

> **[W]hat you need to do is you need to get people on board who want to be on board, and their positivity and their [...] ability to sell it to the rest of the staff is what gets everybody else on board. And that's the way we've always done AVID at [school] and I think that's been the reason why it's been successful, and that's what we've done with maths as well.**
>
> (School 6, participant 6, interview 2022)

These different experiences suggest that to effect change in mathematical teaching and learning, schools' commitment to ongoing professional learning and culture change needs to be considered alongside their resources, including having sufficient funding for a coach and professional learning over a longer term.

5. Sustainability of project outcomes depends on embedding effective practice, strategic alignment and committed school leadership

The importance of embedding effective teaching practice into school culture

Findings from schools that continued the project until 2021 indicated the importance of embedding the high-engagement, primary mathematics strategies so that they became part of school culture. One coach reflected on the importance of embedding the *non-negotiables* through weekly planning in professional learning communities, and consistent and focused assessment practices based on multiple data sources. (School 1, participant 5 journal, 2021) Another affirmed views expressed by her colleagues (School 6, group interview, 2022) when she commented that:

> *We don't see the Myer Maths project as being separate to anything else that we do in the school. It's just part of AVID that we do at our school.*
>
> (School 6, participant 6 interview, 2022)

Similarly, a teacher at a different school talked about how AVID is 'culture now, it's not extra', noting that new staff have also 'embraced' the 'non-negotiable' instructional strategies. (School 2, group interview, 2021) These accounts connect with research supporting the development of collective efficacy through practices including data analysis (Voelkel & Chrispeels, 2006) and the importance of enculturating practice change. (Gibbons, Kazemi, & Lewis, 2017)

Strategic alignment with school priorities is associated with project sustainability

Participants emphasised the importance of strategic alignment for project focus and, ultimately, sustainability. For instance, early in the project a teacher commented that the project was beneficial in 'putting the spotlight on maths'. (School 1, participant 16 interview 2019) At another school, a principal and a teacher commented favourably on alignment between an existing pedagogical approach and the specific, high-engagement, evidence-informed instructional strategies implemented through the project. (School 3, participant 22, 25 interviews, 2019) A teacher at the same school told us about the benefits of being able to use instructional strategies in key learning areas beyond mathematics. (School 3, participant 26 interview, 2019)

Reflecting on the sustainability of project outcomes, one principal commented favourably on the alignment of AVID and the *non-negotiables* with other mathematical coaching previously provided to school staff by an external expert. (School 1, participant 15, group interview, 2021) The coach at another school observed that a shift in the school focus to numeracy had been positive for her role (School 2, participant 12 interview, 2022), with her principal affirming that this had enabled a 'deeper look' at mathematics. (School 2, group interview, 2021) However, another teacher at the school reflected that changing school priorities had been a factor in a shift away from a strong focus on the *non-negotiables* from 2020. (School 2, participant 8 interview, 2022)

Participants also reflected on the strategic alignment between the project and broader objectives that appear beneficial for sustainability. One school principal recounted how the mathematics coach had facilitated school-wide professional learning online during periods of lockdown that set teachers up to deliver a new syllabus. (School 6, group interview, 2022) That coach told us how the project had been a platform for a focus on mathematics that will continue with a new professional learning focus on teaching and learning place-value. (School 6, coach participant 6 interview, 2022)

Several teachers reported positive outcomes for students in moving from Year Six into secondary school.

> **Four/five years ago in a row now I've had Year Sevens come back the next year and thank me and everyone here because of how easy it is to transition to an AVID secondary school and be effectively a year ahead of everyone else [...]**
>
> (School 1, participant 11 group interview, 2021)

Irrespective of the project outcomes that

participants told us about, the role of committed school leadership appeared as a critical factor in the sustainability of project outcomes.

The importance of committed school leadership for project sustainability

After the principal, teachers and coach at one school told us about project outcomes late in 2021, several changes in that school's leadership occurred. The mathematics coach left the school to take up a leadership role at another school, the principal left the school at the end of 2021 and a new principal commenced in 2022. The school subsequently withdrew from the AVID system of school improvement in 2022. (personal communication, 2022)

In contrast, at the other two schools that continued with the project until 2021, both principals expressed a commitment to sustaining project outcomes and related school culture, with slightly different emphases. One principal reflected that:

> **[I]t's just been such a great system of strategies to have in our school, that's supported good quality pedagogy. I think we're proud to be an AVID school, and we will continue to be an AVID school for a long time, I believe.**
>
> (School 2, participant 17, group interview, 2021)

The other linked a commitment to sustaining project outcomes to ongoing reflective practice:

> *[W]e're probably coming off the back of a period of really good success in the last few years. We've really changed community perception of our school in curriculum, in resourcing, in behaviour, wellbeing, pretty much everything. And it's one of those times [...]*
>
> **when things are going well it's easy to pat each other on the back and say how well we're going, how great a place to work, but [...] it's actually now when you're doing well that you've really got to lift your game. Because that's when things fall apart when you start to think 'Oh how good are we, how well are we going.'**
>
> (School 6, participant 9 group interview, 2022)

Taken together, these reflections suggest the vital importance of committed school leadership in sustaining the achievements for primary mathematics from the project outcomes.

Recommendations

Our findings suggest support for the project's theory of change. They also offer practical insights into building and maintaining sustainable improvements to teachers' mathematical confidence and capabilities that lead to improvements in students' mathematical confidence and capabilities. Based on our findings, we recommend:

1.

A multi-layered and distributed approach to primary mathematics instructional coaching to build teacher confidence and capabilities in teaching mathematics over time. This approach needs to be built on sustaining relationships of trust and involve teachers in customising their teaching goals. Coaches need ongoing professional learning and support to develop in the role over time.

2.

Ongoing professional learning that is customisable and adapted to context, and supported by evidence-informed, instructional primary mathematics strategies and practical resources. In this project the AVID system of school improvement provided this structure through continuous, customisable professional learning and many subject-specific resources.

3.

Funding for time release of a part-time primary mathematics coach to initiate capability building and facilitate changes to teaching practice over time. This was initially provided by project funding with contributions from participating schools; however, schools demonstrated varied capacity to meet funding requirements. Notably project design had involved a gradual release of funding to help schools build funding capacity to prioritise funding a primary mathematics coach.

4.

Embedding consistent primary mathematics teaching practice and ensuring strategic alignment with other pedagogical approaches to sustain teaching and learning culture change within a school. In addition, committed leadership is important for sustaining change in teaching practice and student learning.

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AVID Myer Mathematics Trial

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