Strategies That Promote Inclusive Mathematics Education

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In this symposium, we continue the discussion on attending to student diversity in mathematics education (Quane et al., 2024) by exploring strategies that promote inclusive mathematics education. In doing so, we continue to acknowledge that classrooms comprise of diverse student populations (Quane et al., 2024) with Australian classrooms experiencing higher proportions of diversity than the international average. In terms of equity and inclusion, Australia, according to a recent OECD report, is one of four OECD countries whose education systems did not have a "formal or operational" definition of inclusion (OECD, 2023, p. 25). This is problematic as there is no consensus on a common definition, and, therefore, interpretations of what inclusion means are inconsistent. In turn, a lack of a standard definition of inclusion may result in educational practices that do not align with the principles of inclusion. Of note, the Early Years Learning Framework does provide a definition of inclusion for the education of children (birth to eight years).

Cologon and Mevawalla (2018) describes genuine inclusion as comprising of "belonging, participation, opportunity and recognised and valued contribution" (p. 904). Cologon and Mevawalla (2018) continue and state that "genuine inclusive education requires embracing and addressing all aspects of human diversity through attitudinal, structural, relational, and environmental accommodations. Inclusive education is a 'big idea', but it is lived out in everyday moments in the interactions between people and environments" (p. 904). Slee (2019) posits that inclusive education is achieved when "excellent educational experiences and outcomes *for all children* (emphasis added) and young people" are provided (p. 8). In this symposium, we revisit the definitions of inclusion and diversity and explore strategies that promote inclusive mathematics education.

Chair: Kate Quane

Paper 1: *Universal Design for Learning for Mathematics Education*

Lorraine Gaunt, Kate Quane, Belinda Trewartha and Tom Porta

Paper 2: *The Use of Key Word Sign to Support Early Mathematical Learning*

Kate Quane, Belinda Trewartha, Lorraine Gaunt, Elaine Stigwood and Zoe Twose

Paper 3: *Let's Throw Out the Textbooks and Streaming in Mathematics!*

Lorraine Gaunt and Matt Winslade

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Universal Design for Learning for Mathematics Education

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In this first paper of the Symposium: Strategies that promote inclusive mathematics education, we introduce the Universal Design for Learning (UDL) guidelines through a mathematics lens. Using a rapid review, empirical studies on mathematics and UDL in early years, primary, or secondary school settings were sought. Six research papers were identified from school settings with no results for early years research, thus, the Early Years Learning Framework was used to identify connections to mathematics in this context. Findings highlighted the potential of UDL to enhance mathematics education for all students creating a flexible and accessible curriculum.

Universal Design for Learning (UDL) is seen to be widely adopted as a framework for accessibility in inclusive education environments (CAST, 2024). The use of UDL to teach mathematics in inclusive settings is a progressive approach that aims to accommodate the diverse needs of all students, not just students with disabilities (Craig et al., 2023). By exploring recent research, this article aims to offer insights into the application of UDL in mathematics education, highlighting its potential benefits and challenges across early years, primary, and secondary education. Craig et al., (2023) highlighted the correlation between effective UDL implementation and student performance on standardised tests. This demonstrates the importance of examining effective examples of pedagogy that apply UDL principles to promote equity and accessibility to mathematics instruction for all students. By examining recent research, we aim to answer the question, "How can teachers use a universal design for learning approach to promote inclusive mathematics education for all students?" The significance of this study is that we hope to highlight the transformative potential of UDL in creating inclusive mathematics classrooms thus promoting just and equitable access to mathematics for all.

What is Universal Design for Learning?

Universal Design for Learning (UDL) leverages our understanding of the human brain, recognising that each brain is unique, much like fingerprints (CAST, 2024). UDL 3.0 provides guidelines to help educators cater to this diversity through three main principles:

- **Engagement (the why of learning):** Recruiting interest, sustaining effort and persistence, and self-regulation.
- **Representation (the what of learning):** Perception, language and symbols, and comprehension.
- **Action and Expression (the how of learning):** Physical action, expression and communication, and executive function.

The UDL Guidelines provide evidence-based recommendations and prompts that can be integrated into any educational setting to help support teachers to ensure that every student has the opportunity to engage in meaningful and challenging learning experiences (CAST, 2024). In July 2024, a new update to the UDL guidelines was released (CAST, 2024), addressing gaps and biases to better reflect students' diverse perspectives and identities. The updates aim to reduce barriers by promoting more just and equitable learning environments. The revised guidelines incorporate current research and focus on fostering purposeful and reflective learner agency, collective knowledge generation, and addressing systemic biases, making them more relevant and effective for today's diverse educational contexts. In light of the release of the new guidelines and the increasing understanding that the UDL framework can be used to support all students in all subjects, the authors reviewed recent literature to identify how UDL has been used in mathematics education across early years, primary, and secondary education.

Method

A rapid review was conducted to explore how a UDL approach can promote inclusive mathematics for all students, following PRISMA guidelines. Cirkony et al. (2022) describe a rapid review as providing timely contextual information. We used "universal design for learning" AND "mathematics" as search terms in EBSCO, focusing on full-text articles in English published from 2015. Initially, 56 articles were found, but after reviewing titles and abstracts, only six met the criteria. These included empirical research on UDL in early years to secondary school settings with data on UDL for mathematics. No pre-formal schooling papers met the criteria, so the Early Years Learning Framework 2.0 was used to connect to UDL principles. Of the six papers, three had a primary school focus (Buchheister et al., 2017; Hunt et al., 2022; Rodríguez-Ascaso et al., 2018), and three had a secondary school focus (Franz et al., 2016; Kaur & Prendergast, 2023; Root et al., 2020). In describing strategies documented in the research literature, we use the current UDL 3.0 guidelines, noting that there has been changes in the design options and language used in the reported papers.

Universal Design for Learning in the Early Years

The Early Childhood Education and Care sector (ECEC) in Australia ranges from birth to eight years of age. In this discussion, we focus on the pre-formal schooling ages of birth to five years. Whilst the UDL framework is not referred to in the Early Years Learning Framework (EYLF2.0), the principles espoused by UDL are embedded throughout the EYLF2.0 and ECEC teaching and learning strategies (AGDE, 2022). The 'universal' is reflected in national frameworks and governing bodies that view the child as a competent, capable learner that has the right to high-quality, inclusive education (AGDE, 2022). The EYLF2.0 describes curriculum as encompassing "all the interactions, experiences, routines and events, planned and unplanned, that occur in an environment designed to foster children's learning, development and wellbeing." (AGDE, 2022, p.7). In this way, the EYLF2.0 aligns with the principles of Engagement, Representation, and Action and Expression.

Engagement in ECEC is based on a pedagogy of relational and place-based philosophies, prioritising a deep understanding of the individual, families, and communities, and respect for diversity (AGDE, 2022). By working in partnership with children and their families, learner agency and opportunity to co-construct curriculum flourishes. The principles of universal access and recognising that learning is about prioritising an individual's funds of knowledge (AGDE, 2022) are at the core of this strengths-based approach. Representation is inspired by the children, the environment, and context. Provocations are informed by the children's interests and are not fixed, but open-ended. This type of curriculum acts as a catalyst to create inquiries and experiences that are multi-modal, such as exploration tables and constructive play situations, that are supported and modelled by resources that are rich in culturally appropriate and inclusive language, representative of children's one hundred languages and their multi-modal forms of expressions (AGDE, 2022; Malaguzzi, 1996). The provision of flexible workspaces and play-based learning, provides multiple entry points that cater to individual goals and facilitates co-construction for all children. Action and Expression is encouraged through careful consideration of Engagement and Representation that supports multi-modal expression and communication.

Universal Design for Learning in the Primary and Secondary Years

The identified primary papers documented two strategies. First, how games and game-based learning can cater for the individual needs of all students by giving a thorough consideration to the UDL guidelines. Second, applying the UDL guidelines to create and use videos with accessible content to teach prime numbers.

Drawing on the principles of multiple modes of presentation, expressions, and engagement, Buchheister et al. (2017) advocates games as a strategy to meet the needs of all students. Games, according to Buchheister et al. (2017) are a strategy that not only can be used to "address mathematical content, reasoning and problem solving" but do so in a way that meets the needs of individual students (p. 7). The use of games can be a strategy that encourages students to use "more sophisticated strategies" (p. 10), make connections between representations, and communicate their mathematical thinking and reasoning whilst developing positive dispositions such as perseverance. Buchheister et al. (2017) found students to be motivated by the mathematical content and the desire to develop their mathematical reasoning. Variations provided further opportunities to engage in the mathematical content of the game while building connections. In using games, Buchheister et al. (2017) recommends that teachers "anticipate our students' diverse needs" and provide learning opportunities that have "multiple entry points so that all students can engage" (p. 12). Hunt et al. (2022) support a game-based curriculum with UDL, recommending after-game sessions for students to create, share, and revise explanations and justifications, using digital tools like Padlet and Google Jamboard. Both studies highlight the affordances of UDL in making mathematics content accessible and engaging.

Rodríguez-Ascaso et al. (2018) applied the UDL principles to producing and using mathematical videos for year 6 "non-disabled" students focusing on all three UDL principles. Rodríguez-Ascaso et al. (2018) found that videos that had "higher levels of saturation and lightness of colour" were preferred design options and that the colour red "should be avoided" (p. 13). In terms of sustaining effort, Rodríguez-Ascaso et al. (2018) reported that providing students with a written script which provided descriptions concurrently reduced the cognitive load of students.

The identified secondary papers identified two key strategies that support equitable access to all students in the mathematics classroom in secondary settings. First taking a problem-solving approach to mathematics and second, focusing on language and literacy in mathematics.

Problem-solving in mathematics education is a key foundation that supports students to work mathematically and develop the four proficiencies in mathematics as identified in the Australian Curriculum Mathematics. Franz et al. (2023) identified that key traits of problem-solving pedagogy align with UDL. For example, encouraging students to use multiple means of representation using various tools and methods, such as diagrams, tables; providing multiple means of action and expression by encouraging students to reason abstractly and quantitatively; using various methods to represent mathematical problems; and providing multiple means of engagement by encouraging students to construct and critique arguments. Franz et al. (2023) also dispel some myths of traditional instruction, such as requiring students to learn procedures before concepts, to be competent at computation before they can tackle more complex problems and assuming some students are just 'not math people'. Particularly for students with learning disabilities, traditional mathematics instruction often neglects problem-solving skills which can hinder their progress (Root et al. 2023). By applying UDL principles, educators can create a more inclusive learning environment that supports the development of problem-solving skills for all students.

Thomas et al., (2023) explored how the UDL framework can be applied to address the language demands in mathematics education. Highlighting the relationship between mathematics, language, and literacy, providing various ways to represent mathematical concepts, such as visual aids, manipulatives (e.g. blocks), and technology (e.g. mathematical notation software), can help students understand and engage with the material. By allowing students to demonstrate their understanding through different methods and creating an inclusive classroom environment, educators can make mathematics more accessible and engaging for all students. Kaur and Prendergast (2023) found that encouraging written reflections about their problem-solving processes allowed students to demonstrate their understanding through different means of action and expression. This led to increases in students' enjoyment and self-confidence in mathematics, enhancing students' metacognitive thinking.

Discussion

This paper highlights the potential of the UDL framework to enhance mathematics education of *all* students in inclusive settings. By providing multiple means of representation, action and expression, and engagement, UDL can create a more flexible and accessible curriculum that accommodates the diverse needs of all students. The strategies identified, whilst specific to an education sector can transcend throughout the schooling years. However, the successful implementation of UDL requires ongoing professional development for teachers and support from educational institutions. Educators must be equipped with the knowledge and skills to design and deliver instruction that meets the needs of all students. Thus, further research into the practical application of UDL principles in mathematics contexts is required. By embracing the principles of UDL, educators can create a more inclusive and effective learning environment, ultimately leading to better educational outcomes for all students.

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The Use of Key Word Sign to Support Early Mathematical Experiences

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The use of semiotic resources in the teaching and learning of mathematics has a rich history in mathematics education. This paper explores how Key Word Signs can be used as a communication strategy, providing opportunities for children and teachers to communicate their mathematical ideas. We report on the initial phase of research, which involves identifying signs that are developmentally and conceptually appropriate for preschool-aged children. In doing so, we share our findings of 20 Key Word Signs that can be used in the teaching and learning of position and direction concepts.

The use of gestures to communicate has a long history with Peet (1886) recognising gestures as a "natural language" over 140 years ago (p. 262). Peet (1886) argued that "every effort be made to communicate with the child by motions of the hands and expressions of the countenance" using recognisable signs associated with objects and concepts (p. 262). A single gesture can have multiple meanings, depending on the context and the cultural meanings attached to a gesture. For gestures to be recognisable, they need to be consistently used in terms of their production and meaning. At a similar time to Peet (1886), Peirce is acknowledged as describing this process as semiosis, involving three key elements: a sign, it's object, and it's interpretant (Oehler, 1987). Key Word Sign (KWS) is an augmented communication strategy that formalises and consistently uses the same gestures to represent words or phrases.

Research into the use of KWS has investigated pre-service teachers' beliefs into the benefits and suggested ways to implement KWS in early childhood settings (Cologon & Mevawalla, 2018), preschool children with Autism Spectrum Disorder (Rose et al., 2016), and children with developmental disabilities (Dark et al., 2019). More recently, KWS, has been cited in the South Australian government Preschool Curriculum Resources (DECD, 2024) as a way to support children's active participation. While KWS is a strategy to support individuals with communication difficulties, we argue that KWS is a communication strategy that would benefit all students to communicate with one another.

Key Word Sign and the Preschool Years

The Early Childhood Education and Care sector (ECEC) in Australia ranges from birth to eight years of age. In Queensland, where this research will take place, preschool is called Kindergarten and caters for children who are turning four years of age in the year before starting school. It can be delivered in stand-alone centres and long-day care, both privately and state-owned. The Early Years Learning Framework 2.0 (EYLF2.0), (AGDE, 2022) is the guiding Framework that all Australian ECEC centres must adhere to in their teaching and learning practices. It is founded on the image of the child as being a capable and confident learner and on the principles of being, becoming, and belonging.

Outcome 4 of the EYLF2.0, highlights the importance of children sharing their ideas, collaborating, questioning, and responding to others, as well as the importance of educators modelling mathematical language and engaging in mathematical discussion (AGDE, 2022). Educators are encouraged to teach skills enhancing self-expression and communication while recognising that competence transcends language, dialect, or culture. EYLF2.0 acknowledges multimodal communication as vital, stating that children use gestures, sounds, language, and visual communication, including signing. KWS provides this opportunity for access and inclusion for not only non-verbal children to communicate but all children to access another tool that empowers their communication strategies.

Key Word Sign (KWS) is a widely recognised, unaided Augmentative and Alternative Communication (AAC) strategy. In Australia, KWS integrates signs from Australian Sign Language (Auslan) alongside natural gestures to visually highlight the keywords in spoken sentences (Leon, 2024). For individuals using KWS for communication, signs and gestures can support and enhance their speech or provide an effective alternative when spoken communication is not possible. Leon (2024) found that combining manual signing with spoken language supports individuals with developmental disabilities, improves communication, and fosters speech development. Moreover, the benefits of pairing manual signs and gestures with speech extend well beyond specialised communication contexts. Studies show significant advantages for typically developing children, including enhanced literacy skills (Daniels, 2000), improved foreign language learning (Gracie-Gamez, 2023), and greater mathematical understanding and retention (Kersey 2024). This use of gesture, combined with oral and aural communication, is a semiotic bundle that adds another set of tools to allow children agency in communicating their conceptual understandings.

Key Word Sign and Developing Early Mathematical Concepts

From a very young age, spatial thinking develops, initially as a response to learning and then developing into an understanding of spatial orientation by exploring where they are in relation to the things around them and the language of position and movement. Children also engage in cue learning by using external-based systems based on the context of their environment (Sarama & Clements, 2009). According to Sarama and Clements (2009), by the age of two years, children use spatial relational words more frequently than naming objects. Position and direction were chosen as the mathematical focus in this project as they are seen as fundamental concepts that influence children's mathematical achievements in later years (Sarama & Clements, 2009). 'In', 'on', and 'under' are the first spatial prepositions young children learn at around fifteen months of age (Sarama & Clements, 2009). Vertical directionality terms such as 'up' and 'down' are next, followed by proximity words such as 'beside' and 'between' and reference terms such as 'behind' and 'in front of' (Sarama & Clements, 2009). Children often develop or are in the process of developing conceptual understandings as this language is introduced by adults, and in turn, the introduction of this language helps consolidate emerging understandings.

The Project

In this paper, we report on the initial phase of the project, identifying mathematical concepts pertinent to the development of young children's mathematical understanding. The project aims to provide communication strategies using KWS whereby children can communicate their mathematical thinking and understanding to others. Responding to the needs of children, the project will provide targeted professional learning that uses KWS to communicate core mathematical concepts related to position, direction, and movement of objects. The research aims to answer the following research questions:

- In what situations do Early Childhood Educators, Teachers and children use Key Word Sign to support the mathematical development of children?
- How do children use Key Word Sign to communicate their mathematical understanding of position, direction and movement of objects concepts?

To answer the above research questions, a preliminary analysis was needed to identify the Key Word Signs to be used and suggest contexts and situations in which they could be used.

Key Word Signs

The research team met to discuss the mathematical focus of the study. Drawing on existing literature, we found that understanding the position and direction of objects and people were fundamental concepts in the early years. The Queensland Curriculum and Assessment Authority (QCAA) identifies "using everyday language to describe shapes, directions and positions" as significant learning as part of the key focus of "exploring numeracy in personally meaningful ways in kindergarten (Queensland Curriculum and Assessment Authority, 2018, p. 30). From our review, we identified 20 signs that can be used to explore position and direction. Table 1 lists the mathematical concepts that were identified.

Table 1

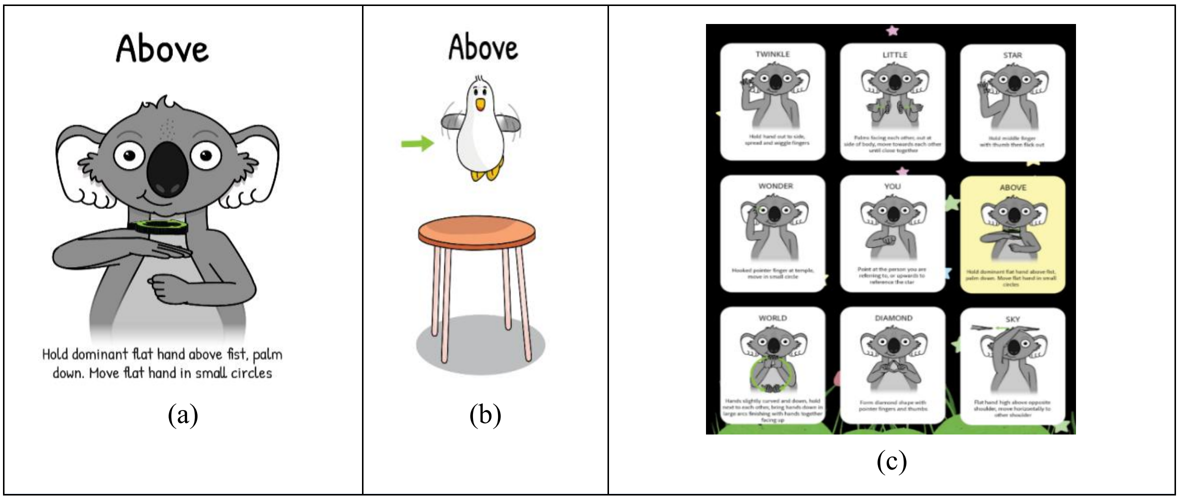
20 Key Word Signs for Position and Direction

Position and direction				
In	Under	Up	Forward	Inside
Out	Below	Down	Backward	Outside
On	Above	Open	Around	Top
Off	Over	Close	Through	Bottom

The 20 signs were verified by an Auslan interpreter who identifies as a Child of a Deaf Adult (CODA). The Auslan interpreter provided the following endorsement for the 20 signs "All illustrations used in the resource are accurate and depict each sign correctly. There are no comments on expressions as these are non-emotive signs in this context. The resource has been thoroughly researched and produced very carefully. Therefore, I would comfortably endorse the resource as well-suited for its purpose". From the list, Sunshine Sign and Sing developed educational resources. These included posters for each KWS including a description on how to produce the sign (Figure 1a), a poster to show the mathematical concept (Figure 1b) and a range of books, videos, and posters with the sign used in context (Figure 1c).

Figure 1

Key Word Sign Resources Developed for the Project



(a) (b) (c)

Conclusion

In this paper, we have shared the early phases of a research project that explores the use of Key Word Sign in the preschool years to explore mathematical concepts. The EYLF2.0 acknowledges that not all children communicate verbally or understand verbal communications. By formalising gestures and integrating them with spoken language, KWS promotes active participation and conceptual learning and as such an effective strategy for enabling *all* children, to express their understanding of mathematical concepts like position, direction, and movement. The project's development of resources, verified by expert endorsement, underscores the potential of KWS to transform how educators support young learners in building mathematical and communication skills, laying a foundation for lifelong learning and inclusion.

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Let's Throw Out the Textbooks and Streaming in Mathematics!

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This paper reports on an innovative project which enhanced professional learning for in-service and pre-service teachers in a regional setting. By fostering collaborative mentor-mentee relationships and co-designing professional development activities, the project improved mathematics teaching practices and student outcomes. Utilising Breakspear's Teaching Sprints model, this project emphasised continuous learning and reflection. Key findings highlight the positive impact on teacher confidence and practices and improvements in student outcomes. The project demonstrates the potential for professional development to drive pedagogical changes.

In education, the professional development of teachers is paramount to ensuring high-quality teaching and learning experiences (Australian Institute for Teaching and School Leadership, 2018). This collaborative professional learning project between a regional university and local school, aimed to address the professional development needs of both in-service teachers (ISTs) and pre-service teachers (PSTs) in regional settings (Clarke & Winslade, 2019). This article focuses on one outcome of the three-year professional development partnership. The project's innovative approach led to significant changes in teaching practices, particularly in mathematics education, and has provided valuable insights into the benefits of collaborative professional development.

Context and Background

This professional learning project operated within a regional primary school characterised by a dedicated staff with many years of experience, but a traditional approach to professional development. This setting underscores the necessity of innovative professional learning activities that engage both ISTs and PSTs. The project is built on a foundation of mutual trust and collaboration. With schoolteacher support playing a critical role in training PSTs, a partnership between school and university offers the potential for mutually beneficial outcomes (Clarke & Winslade, 2019). The regional context presents unique challenges, such as limited access to professional learning resources and opportunities, making the project's efforts even more crucial (Ferns & Lilly, 2015). By fostering a supportive and collaborative environment, this project aims to rejuvenate the professional learning landscape and enhance the quality of education in these areas.

Research has shown that staff recruitment and retention in regional and rural schools is challenging (Burke, & Buchanan., 2022) with over 65% of teaching staff in rural, regional, and remote schools being in their first two years of teaching. This has implications for the availability of appropriate professional learning for a regional context and the readiness of ISTs to provide appropriate mentoring support to PSTs.

The primary aim of the project was to develop a greater understanding of primary school stakeholder perceptions regarding shared professional learning involving ISTs and PSTs. In this paper, we report on the research question:

What impact does professional development have on ISTs and PSTs when it is co-designed by staff?

The project's dual focus on the professional growth of both ISTs and PSTs highlights the importance of collaborative learning environments. By examining the perceptions and experiences of stakeholders, we hope to provide insights into the effectiveness of co-designed professional learning and its impact on teaching practices and student outcomes.

Methodological Framework and Model

The project employs a mixed-methods approach, including the examination of school reports and documents, the collection of quantitative survey and questionnaire data, and the use of semi-structured interviews. The initial focus is on establishing local partnerships for continued professional learning in regional settings, to support the long-term retention of teachers in these areas. PSTs are prioritised for placement at the partner school, where they participate in professional learning alongside their mentor teachers. This approach ensures that professional learning is contextually relevant and tailored to the specific needs of this regional school. The professional learning model is based on the Teaching Sprints model by Breakspear and Jones (2021), which involves three key phases:

1. Prepare: Identify the focus for professional development and engage in new learning.
2. Sprint: Intentionally practice new learnings in classrooms.
3. Review: Reflect on the process, share insights, and identify next steps.

This model allows for authentic professional conversations, planned implementation, and reflection, with PSTs and their mentors learning side by side. The cyclical nature of the teaching sprints model promotes continuous improvement, enabling teachers to refine their practices and address emerging challenges effectively (Breakspear & Jones, 2021).

The Mentor-Mentee Relationship

The mentor-mentee relationship is central to the project's success. Traditional mentoring approaches often position mentors as the authority and expert, with their experience privileged over that of the mentee (Spooner-Lane, 2017). However, this project adopts an educative mentoring approach, where the mentee is an active participant in the relationship (Aspfors & Fransson, 2015; Larsen et al., 2023). This collaborative approach values the experiences of both mentor and mentee, fostering a climate of mutual learning and growth. By emphasising the reciprocal nature of the mentoring relationship, mentors are also encouraged to reflect on their own practices and learn from their mentees, creating a dynamic and supportive professional learning environment.

The Mathematics Education Journey

The professional learning model fostered collaboration among teachers, promoting continuous professional learning, building confidence in teaching abilities, encouraging innovative pedagogical and reflective practices. This led to more effective and engaging learning experiences for students. In the first year of the project, teachers identified a focus on improving mathematics outcomes and worked to identify and implement effective pedagogical practices through the use of prepare, sprint, and review (Breakspear & Jones, 2021). In the second year, the school made the decision to change their school approach to streamed mathematics groups and reliance on textbooks in the mathematics classroom and shifted to mixed-ability classes. Professional learning alongside PSTs continued. In the third year, improvements in Progressive Achievement Tests in Mathematics (PAT-M) data (Australian Council for Educational Research [ACER], 2015) validated the new approach, leading to sustained focus on mathematics professional learning.

Results

The results of this study reveal positive outcomes in three key areas. First, ISTs reported a notable increase in their confidence levels, enhancing their teaching efficacy. Second, PSTs felt more integrated into the school community, fostering a supportive and collaborative environment. Third, improvements were observed in the PAT-M assessment results, with growth data indicating increased performance across all year levels.

Initial survey and interview data reveal positive outcomes for both ISTs and PSTs. ISTs reported increased confidence in their teaching and the ability to broaden their teaching ideas through time to collaborate with colleagues and discuss classroom practices. PSTs felt more integrated into the school community and valued the opportunity to build relationships with other teachers beyond their mentor teacher. One mentor noted the value of learning together with their PST stating, "Seeing what he was pulling out from his current university studies and how it matched up with our evidence-based research, …we learned together, and it was brilliant." Similarly, a PST noted, “We took what we learnt, and I’d implement it in class, and then he [mentor] would and I’d observe... and then we would reflect... and learn together”, highlighting the importance of creating a supportive and collaborative professional learning environment that values the contributions of all participants.

School data showed improvements in PAT-M growth data when compared with state norms. Teachers felt that the shift away from traditional textbooks and streaming, combined with the Professional learning, allowed them to adopt more flexible and student-centred instructional approaches, leading to improved student engagement and achievement in mathematics. Table 1 shows a snapshot of 2022-2023 data for students in year 4 (2022).

Table 1

PAT-M Growth Data: Yrs 3 – 4 & Yrs 4 - 5

	2022		2023	
Percentiles	**PAT NORMs**	**HPS**	**PAT NORMs**	**HPS**
95th	3.1	3	6.3	11.4
75th	4.6	4.7	6.6	6.6
50th	5.7	7.3	7.4	7.4
25th	6.7	4.4	7.2	7.2
5th	8.2	5.7	2.2	1.8

Table 1 tracks the PAT-M growth of students for the partner school (HPS) from Year 4 in 2022 to Year 5 in 2023. Comparing HPS growth to the state average (PAT Norms) in 2022, HPS students generally showed equal to (75th percentile) or less growth (5th, 25th and 95th percentiles) compared to the state average. The exception was the 50th percentile (the average student), which showed a growth of 7.3% compared to the state average of 5.7%. This indicates that for most students, their growth from year 3 to 4 was at or less than was expected by the state norm. In contrast, the 2023 data indicate greater growth for HPS students compared to the state norms for all students except the 5th percentile students, where growth was slightly less. The 95th percentile showed a growth of 11.4% compared to the state average of 6.3%, and the 50th percentile showed a growth of 7.4% compared to the state average of 4.4%. This suggests that HPS students made more progress in 2023, outperforming the state average across most percentiles. The data highlights the potential effectiveness of the professional development initiatives implemented at HPS, leading to improved student outcomes.

Discussion

The project highlights the transformative potential of collaborative professional learning in enhancing teaching practices and supporting the professional growth of both ISTs and PSTs. A key finding is the importance of a collaborative mentor-mentee relationship, which fosters mutual learning and professional growth. This relationship allows both mentors and mentees to reflect on their own practices and learn from each other, creating a dynamic and supportive environment. The positive impact of co-designed professional development on teacher confidence and teaching practices is noteworthy. By involving teachers in the design of their professional learning activities, the project ensures that the development is relevant and tailored to their needs, leading to increased confidence and a broader range of instructional strategies. The potential for professional development to drive changes in pedagogy and improve student outcomes is highlighted. Through continuous learning and reflection, teachers are able to adopt innovative and effective teaching practices that enhance student engagement and achievement. This was seen in the changes in mathematics pedagogical practices and improved student outcomes as shown by the PAT-M results.

The findings of this project had a transformative impact on teaching practices and student outcomes. The collaborative professional learning activities, grounded in Breakspear's Teaching Sprints model, fostered a culture of continuous learning and reflection among teachers. This approach enhanced teacher confidence and broadened their instructional strategies, leading to notable improvements in student engagement and achievement, particularly in mathematics.

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