Pedagogy in Mathematics

aamt

The Australian Association of Mathematics Teachers Ltd.

Our position

No single pedagogical approach can meet the needs of every mathematics learner. Effective mathematics teaching relies on a range of intentional and high-quality practices that can be tailored to specific contexts, learners and purposes. This position paper advocates for a flexible approach to mathematics pedagogy that empowers school leaders, decision-makers and teachers to make informed professional judgements. School leaders and decision-makers are instrumental in fostering cultures that equip, support, and empower teachers to make thoughtful and informed pedagogical choices. Teachers are encouraged to develop and deploy a diverse repertoire of strategies, grounded in both research and practical insights, to create responsive mathematics learning environments for all students.

Understanding the current context

Mathematics education today is shaped by diverse and often competing priorities from multiple sources such as policy mandates, curriculum and assessment expectations, educational research and societal influences. Adding to this complexity is the variety of pedagogical approaches, each underpinned by different theories of learning, beliefs about learning and teaching mathematics, and varying purposes for mathematics education. These multiple voices and viewpoints can create uncertainty for teachers seeking to make sound pedagogical choices.

The role of evidence in teaching practice has become increasingly challenging to navigate, with various forms of research and voices competing for attention. Empirical methods like randomised controlled trials which generate broad findings and meta-analyses which synthesise research from multiple studies may lack the nuance needed for specific classroom contexts. In contrast, qualitative methods —such as case studies, interviews and observations—offer detailed insights into classroom experiences, though they may not generalise as widely. Equally important is the evidence that comes directly from practice: teachers' professional observations and students' own reflections provide immediate context-specific insights. To make sound pedagogical choices, teachers must balance these multiple sources of evidence, integrating broad research findings with local, practical knowledge. Research alone cannot prescribe what works without considering purpose, context and learners.

Mathematics classrooms reflect the diversity of learners within them. Students bring different strengths, prior knowledge, backgrounds and experiences to their learning. They progress at different rates in their mathematical development.

Students construct understanding in many ways and approach mathematical thinking through multiple valid paths. Individual interests, motivations, dispositions towards learning and relationships with mathematics all shape how students engage with mathematical ideas. These differences in how students learn and engage with mathematics mean no single approach can meet all learners' needs. In this context, where teachers must balance multiple priorities, diverse evidence sources and varied student needs, informed and intentional decision-making is essential. Teachers need a flexible repertoire of strategies to respond effectively to these challenges. This approach values professional judgement, empowering teachers to navigate these complexities and respond to the demands of their dynamic classrooms.

A repertoire of strategies

Effective mathematics teachers draw from a rich collection of research-informed practices. These practices encompass a repertoire of strategies to support student learning. These practices centre around three core aspects of mathematics teaching: purposeful planning, developing mathematical proficiency and adapting to and supporting all learners. Each practice serves as a starting point that can be tailored to different needs, purposes and contexts.

Practice 1: Purposeful planning

Success in mathematics learning begins with careful planning. This takes place on short, medium and long time scales. The strategies in this section emphasise the importance of establishing clear mathematical purpose, building systematically on students' prior knowledge and creating coherent learning experiences. Together, these practices form the foundation for students to engage meaningfully with mathematical ideas.

Establishing clear learning goals and success criteria provides direction and purpose for mathematical learning experiences. During planning, teachers identify key mathematical concepts and skills, establish connections to broader mathematical understanding, and develop clarity around what successful learning looks like. When learning goals are clear to teachers, they can support students to understand what they are learning and why, enabling them to focus their efforts, monitor their progress, and take ownership of their learning. Learning goals can be strategically shared with students at the most appropriate point during a learning sequence. In some instances, this will be at the start of a lesson. In others, it may emerge through guided exploration and discussion. The key is ensuring all students develop a clear understanding of both what they are learning and how they will recognise success.

Building on prior knowledge involves identifying and activating students' existing understanding as a foundation for new mathematics learning. To do this effectively, teachers consider prerequisite knowledge and skills, common preconceptions and misconceptions, students' prior experiences, and how current learning connects to future mathematical development. Building on prior knowledge goes beyond assessing what students recall from previous lessons. It is an active process of drawing out what students already know and uncovering their informal understanding and experiences as valuable foundations for deeper engagement with mathematical concepts. By understanding learning progressions and students' starting points, teachers can strategically sequence lessons, anticipate areas of difficulty and provide multiple pathways into new content. As a result, students construct more robust mathematical understanding by connecting new ideas to their existing knowledge and experiences, rather than learning concepts in isolation. This approach makes mathematics feel accessible and connected, deepening understanding and increasing the confidence of learners.

Intentional task selection shapes how students experience and engage with mathematical ideas. Teachers carefully choose and sequence tasks that align with learning goals, offer appropriate cognitive challenge and meaningfully engage all students. This requires considering the mathematics of each task, students' prior knowledge, and strategies for ensuring accessibility while providing opportunities to extend learning. Different types of tasks serve different purposes across a learning sequence, such as introducing new concepts, stimulating mathematical thinking and reasoning, making connections, developing understanding, building fluency and transferring learning. Tasks can range from familiar to unfamiliar, routine to non-routine, simple to complex, and closed to open-ended, with durations spanning quick activities to extended explorations. They may involve students working individually or collaboratively, offer single or multiple entry points, and incorporate technology or non-digital approaches. The key is aligning task features with the intended learning. High-quality tasks can originate from diverse sources, including textbooks, and be adapted to suit specific needs and contexts. However, the effectiveness depends on implementation—the same task can either promote deep mathematical thinking or be reduced to procedural practice. Teachers must select and use tasks intentionally to ensure all students engage with mathematical ideas in meaningful and productive ways.

Making connections involves deliberately highlighting relationships within mathematical concepts, across areas of mathematics, to other learning areas, and between mathematics and real-world contexts to deepen understanding. Connections don't always happen automatically; teachers need to deliberately plan for them. This can be achieved by activating and building on prior knowledge, using multiple representations, linking procedural and conceptual understanding, and helping students recognise the underlying patterns and relationships within mathematics. Real-world contexts can be valuable for sense-making, but they must be carefully chosen to reflect an authentic contextual application of mathematics. Unrealistic situations that require students to pay attention to things they would usually ignore, or to ignore things they would normally assume mattered, can reinforce the misconception that mathematics isn't meant to make sense. When students are supported to make mathematical connections, they develop deeper understanding, see mathematics as a connected whole rather than isolated facts and procedures, and transfer their learning to new situations.

Practice 2: Developing mathematical proficiency

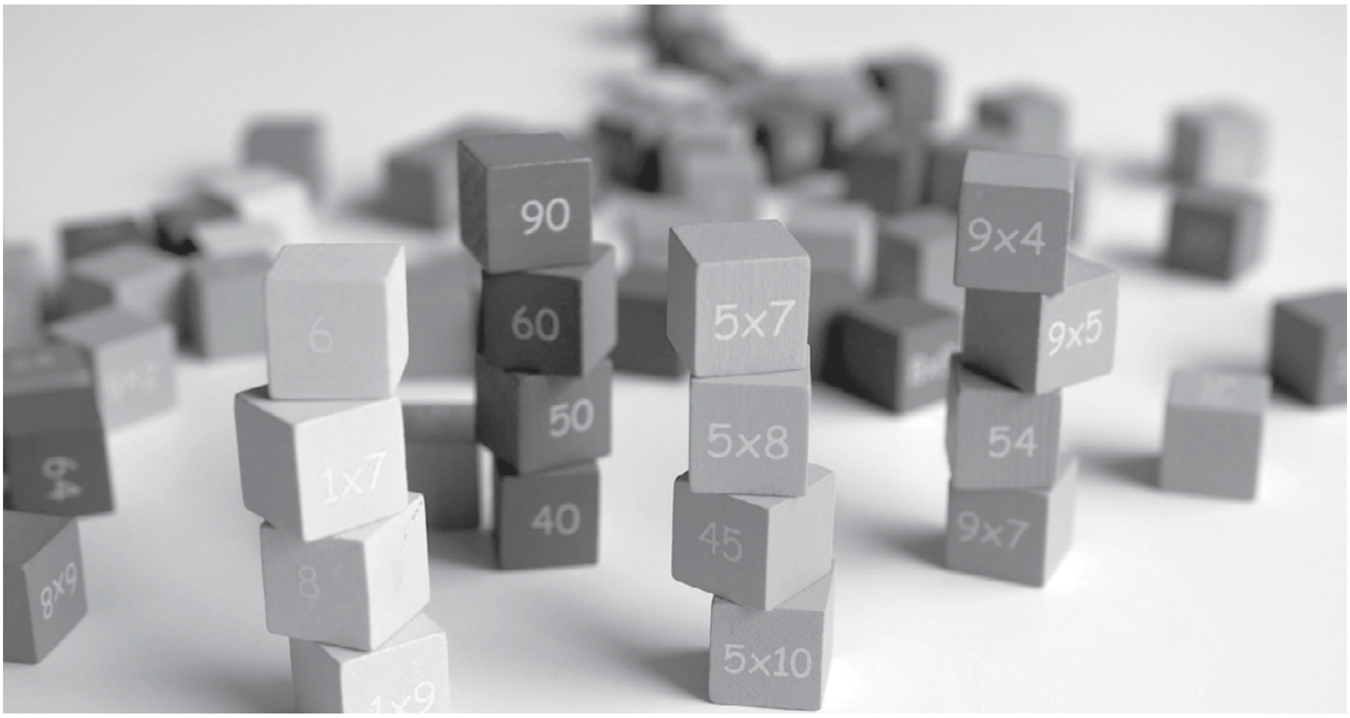
At the heart of mathematics teaching is the development of mathematical proficiency in all its interconnected forms—understanding, fluency, problem-solving, and reasoning. These aspects of proficiency develop simultaneously and reinforce each other; there is no single path to mathematical competence. The strategies in this section work together to help students build mathematical meaning, become confident and proficient in working mathematically, and develop productive dispositions towards mathematics.

Clear explanations help make mathematical thinking visible and accessible to students. This involves teachers demonstrating mathematical processes, articulating thinking aloud, and using correct mathematical language appropriate to learners' development. Teachers carefully consider both the amount of new information presented and how it is structured, using written, visual and verbal explanations strategically to manage students' cognitive load. Explanations should not simply tell students what to do or remove opportunities for student thinking. Instead, they should engage students in making sense of mathematical ideas through structured learning experiences. Worked examples can be a powerful way of demonstrating key concepts and skills, and can be enhanced with self-explanation prompts, comparison with incorrect examples, and gradual removal of scaffolding as students' confidence grows. The timing of explanations—whether given upfront or emerging from structured exploration—depends on the learning purpose and students' current understanding. Ultimately, clear and well-structured explanations support deeper conceptual understanding and help students articulate their own mathematical reasoning

Representations and manipulatives are powerful tools for exploring, understanding, visualising and communicating mathematical concepts. Manipulatives, often associated with early learning, are valuable at all stages of mathematical development. Useful tools include physical and virtual manipulatives, concrete materials, dynamic software, diagrams, graphs, tables, number lines, verbal descriptions, symbolic notation, formulas, equations, real-life examples, metaphors, stories and drawings. Different forms of representations may highlight different aspects of a concept. These tools can serve as scaffolds, supporting understanding until the underlying concept is grasped, at which point they may be removed. Effective teaching involves purposefully selecting representations, focusing students' attention on the mathematical ideas they represent, and encouraging them to compare representations, explore connections and translate flexibly between forms. Students can be supported in interpreting existing representations and generating their own. Engaging with multiple representations and manipulatives helps students access mathematical concepts, transition from concrete to abstract thinking, extend their reasoning, make connections between ideas and build a robust understanding.

Mathematical dialogue and discussion engages students in conversations that make their thinking visible and build understanding. Through these discussions, students articulate and justify their reasoning, actively listen to others' ideas, build on peer contributions, and participate in both whole-class and small group-settings. Teachers play a critical role in structuring meaningful dialogue. They intentionally plan discussions aligned with learning goals, anticipate likely responses and select and connect student contributions. By using inclusive talk moves and establishing norms for respectful discourse, teachers foster participation and ensure all students have equitable opportunities to contribute so that every voice is valued. When implemented effectively, mathematical dialogue deepens conceptual understanding by helping students clarify their thinking, learn from peers and address gaps in knowledge. It also develops reasoning and communication skills, promotes active engagement in mathematical practices, and helps to ensure that all students feel included and capable in mathematics.

Maintaining appropriate challenge fosters mathematical growth by ensuring all students are cognitively stretched, actively participate and feel capable and supported in their learning. Striking the right level of challenge is important: tasks that are too easy can fail to inspire effort, while overly difficult ones can lead to frustration. Motivation stems from various sources, including personal interest, external recognition, and perceiving mathematics as meaningful and worthwhile. While enjoyment plays a role, deeper motivation arises from students' confidence in their ability to succeed and the satisfaction of overcoming challenges through effort. Teachers create supportive learning environments by maintaining high expectations while ensuring students feel safe to take risks and learn from mistakes. This involves using meaningful tasks, scaffolding strategically and giving growth-oriented feedback. A classroom culture that values persistence, curiosity, and sense-making helps students connect effort with achievement. When appropriately challenged in a supportive environment, students develop deeper mathematical understanding, greater persistence, and a more positive disposition toward learning mathematics.



Practice 3: Adapting to and supporting all learners

Students engage with mathematical ideas in different ways and progress at different rates. These strategies help teachers understand and respond to diverse student needs, ensuring all students can access challenging mathematics and progress in their learning. They enable teachers to provide targeted support while maintaining high expectations for all learners.

Differentiated teaching supports all students in accessing, engaging with, and demonstrating mathematical understanding. Each student's strengths and needs vary by topic, shaped by their prior learning experiences, current understanding and individual interests. Teachers use this information to select learning experiences, tasks, scaffolding approaches, and teaching strategies that respond to the diverse needs of their students. They monitor learning, use strategic questioning, provide timely feedback and adjust their teaching to their students. Supportive learning conditions offer multiple pathways for students to process new ideas and demonstrate their understanding. Teachers maintain high expectations of all learners while varying the level and type of support, from scaffolding initial access—by presenting information in different ways and offering varied resources and entry points—to providing opportunities to extend and deepen knowledge. Differentiation does not mean creating separate activities for different groups or individualising every aspect of learning. However, it may involve targeted intervention at key moments to address specific needs. When implemented effectively, differentiated teaching enables all students to engage meaningfully with challenging mathematical content, make progress in their learning and achieve their potential as mathematical learners.

Strategic questioning draws out and develops mathematical thinking through intentional teacher–student interactions. Different types of questions serve different purposes: engaging and motivating students; guiding learning by prompting, focusing and scaffolding thinking; checking, clarifying and probing understanding; deepening comprehension by connecting ideas, exploring generalisations, and extending understanding to new situations; and fostering metacognition through reflective prompts. Effective questioning begins with careful planning, where teachers design questions to align with learning goals and consider how to pose them effectively. In whole-class settings, strategies need to ensure all students have opportunities to participate, not just the quickest thinkers or most confident volunteers. Equally important is how teachers listen and respond to answers — moving beyond evaluating correctness to interpreting and building on responses. Active listening that values all voices fosters a supportive environment, encouraging broader participation. When used thoughtfully, questioning provides valuable insights into student thinking, deepens mathematical understanding and informs teaching decisions.

Practice and consolidation develop mathematical proficiency by providing structured opportunities to revisit, refine, reinforce and apply learning. Rather than being confined to the end of teaching, practice can be integrated throughout learning sequences. Effective practice is deliberately designed to address students' individual learning needs and readiness, recognising that not all students need the same type or amount of practice. Practice goes beyond repetitive tasks by including carefully sequenced activities that vary elements strategically to highlight key features or embed skill-building within richer tasks. Short, focused sessions distributed over time are more beneficial than concentrated blocks. Building on purposeful practice, consolidation helps students secure their understanding and become more effective in applying it. Metacognitive strategies, such as self-questioning, self-monitoring, evaluating one's progress, and knowing when and how to seek help, foster independence and reflection. Other consolidation strategies include collaborative group work, classroom discussion, peer teaching, and transferring learning to new or unfamiliar contexts. The key is ensuring that practice and consolidation work together to build both mathematical competence and confidence, enabling students to use their knowledge flexibly and effectively in a variety of situations.

Effective feedback uses specific information about current understanding to help teachers and students determine the next steps in mathematical learning. Feedback is a two-way process between teachers and students, guided by a clear understanding of learning goals and criteria for success. By gathering evidence throughout a learning sequence, teachers monitor progress and adapt their teaching to better meet students' needs. This information enables teachers to provide timely, concrete, and actionable feedback that helps students understand where they are in their learning and what specific steps will move them forward. Feedback can take many forms, including written comments, classroom discussion, peer interactions, and self-check activities, and it can be directed to individual students or the whole class. Regardless of the format, it needs to be manageable for the teacher to provide and presented in ways that students can understand and act upon. When feedback processes are integrated into teaching, students develop better awareness of their mathematical understanding and take more ownership of their learning, while teachers gain valuable insights to refine their teaching practice.

Framework for action

The following recommendations provide concrete steps for implementing a flexible and responsive approach to mathematics teaching that respects professional judgement and supports all students.

For school leaders and decision makers	For teachers
• Create a culture where teachers are equipped and supported to use different teaching approaches, recognising that no single method works best for all mathematical content or all learners	• Be intentional in selecting strategies based on mathematical purpose, student needs, and classroom context, drawing on professional knowledge
• Support teachers in drawing on and critically evaluating multiple forms of evidence—from research literature to classroom observations—when making decisions about mathematics teaching	• Integrate and critically examine multiple sources of evidence to inform teaching decisions, including research insights and firsthand classroom experiences
• Provide opportunities for teachers to expand their repertoire through professional learning and collegial collaboration	• Build a flexible repertoire of teaching strategies through professional learning and collegial collaboration
• Empower and support teachers to make informed choices about practice based on their specific context, student needs and mathematical purpose	• Exercise professional judgement in selecting and adapting approaches by considering specific context, student needs and mathematical purpose
• Facilitate regular opportunities for teachers to examine and reflect on their practice, expand their professional knowledge, and explore new teaching approaches	• Engage in ongoing reflection to assess the effectiveness of teaching, identifying opportunities to expand professional knowledge, enhance skills, and experiment with new methods

By focusing on building professional expertise rather than prescribing particular approaches, we can create mathematics classrooms where all students are engaged and have the opportunity to succeed.

Acknowledgement of country

AAMT acknowledges the Traditional Custodians of the lands on which we live, work and learn, and we pay our respects to their Elders past, present, and emerging.

We recognise the enduring knowledge, wisdom, and practices of Aboriginal and Torres Strait Islander peoples, including their rich traditions of mathematical understanding. Their contributions to learning and education continue to inform us as we strive for excellence in mathematics education for all Australians.

About this paper

This position paper was motivated by recent debates and discussions surrounding pedagogy in mathematics education, reflecting the growing need to clarify and support effective teaching practices in this vital area. It seeks to provide guidance for educators, school leaders, and policymakers by addressing the complexities of teaching mathematics in today's dynamic learning environments.

The paper draws on a wide body of respected Australian and international research, incorporating insights from leading academic studies, practitioner experiences, and educational frameworks. It represents a synthesis of expertise designed to support informed decision-making and the development of responsive, high-quality mathematics teaching practices.

To complement this paper, AAMT will soon publish a dynamic reading list that includes references and recommended readings that informed this work. This evolving resource will be accessible via our website at:

https://go.aamt.edu.au/2025PedagogyReadingList

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Media enquiries

Members of the media are invited to contact us for further information, interviews, or commentary on this position paper or related topics in mathematics education.

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