

## About thinking, reasoning and working mathematically

### What is thinking, reasoning and working mathematically?

---

Thinking, reasoning and working mathematically is an essential element of learning for, learning about and learning through mathematics. It involves more than acquiring a body of knowledge. Thinking, reasoning and working mathematically involves students in identifying and posing problems, and selecting and applying appropriate strategies to find solutions. It also involves conjecturing and proving, applying and verifying, generalising, using mathematical models, communicating ideas and solutions, and reflecting on learning.

### Why is it important for students to think, reason and work mathematically?

---

The activities that make up everyday life are becoming increasingly mathematical — for example, choosing mobile phone plans, making decisions about best buys or estimating and measuring in cooking. In this world of rapid change, students need more than computational skills. They also need to develop the ability to think and reason mathematically, and to apply mathematics in a variety of situations.

It is important that students be provided with opportunities to see direct relationships between their mathematical studies and the real-life situations they encounter, to solve a range of unfamiliar problems in inventive and creative ways, and to develop a deep understanding of the mathematics involved.

Students also need to develop positive attitudes towards mathematics and towards their own involvement in doing mathematics. When students have opportunities to think, reason and work mathematically, they develop confidence in their abilities to reason, select strategies, apply knowledge, and justify their thinking.

### How is thinking, reasoning and working mathematically used in teaching and learning?

---

Thinking, reasoning and working mathematically involves an active working partnership between students and teachers in a learner-centred environment. In this environment the teacher's role is to:

- develop investigations framed around problems or issues that reflect the needs and interests of students
- guide and scaffold substantive mathematical conversations and provide opportunities to develop the knowledge, procedures and strategies required
- pose questions to stimulate thinking, reasoning and working mathematically, and encourage students to pose problems that utilise similar thinking and reasoning
- provide opportunities for self-monitoring and self-assessment.

The student's role is to:

- be active and self-directed
- make meaningful connections with prior knowledge and experiences, and known procedures and strategies
- identify what it is that they need to know to proceed
- evaluate processes and solutions to determine whether they are appropriate and reasonable
- share information about the knowledge, procedures and strategies on which conclusions are based
- pose problems
- create alternative pathways to solutions.

The Years 1 to 10 Mathematics syllabus promotes thinking, reasoning and working mathematically through an investigative approach in which students are encouraged to create pathways to work through problems to be solved, questions to be answered, issues to be explored or significant tasks to be completed.

Investigations provided in Years 1 to 10 Mathematics support materials exemplify how thinking, reasoning and working mathematically could be promoted through the teaching and learning process. Thinking, reasoning and working mathematically is positioned at the centre of the three phases of learning:

- Identifying and describing
- Understanding and applying
- Communicating and justifying.

## What is the student's role in each of the phases?

---

### 1. *Identifying and describing*

Students encounter mathematics in many aspects of their daily lives. They need to be given opportunities to identify these situations and describe the mathematics that may assist them in finding solutions.

Thinking, reasoning and working mathematically in this phase of an investigation is exemplified by students:

- describing an investigation in their own words
- linking the investigation to known mathematics
- identifying situations that require similar thinking, reasoning and working mathematically
- identifying the mathematics required for an investigation
- revising and clarifying knowledge, procedures and strategies
- identifying and negotiating possible pathways through an investigation.

### 2. *Understanding and applying*

Mathematical thinking and reasoning is developed as students are encouraged to choose strategies and procedures, and to check and verify the application of these strategies and procedures in a range of familiar and unfamiliar situations. Students attempt to acquire an understanding of new knowledge and processes, and apply their mathematical knowledge, in this phase. They continue to clarify and refine their thinking as well as listen to the explanations and reasoning of others as they work on investigations independently or cooperatively.

Thinking, reasoning and working mathematically in this phase of an investigation is exemplified by students:

- representing problems using objects, pictures, symbols or mathematical models
- applying previously learned mathematics to progress through an investigation
- developing new mathematical knowledge, procedures and strategies appropriate to an investigation
- experimenting and testing new knowledge, procedures and strategies
- representing and recording mathematical ideas in different ways relevant to an investigation
- generating possible solutions
- considering the reasonableness of solutions
- validating their findings by observation, trial or experimentation
- exhibiting self-correcting behaviours.

### 3. Communicating and justifying

Students reflect on and generalise about their learning and explain their perceptions. They communicate their solutions or conclusions, and attempt to convince their peers that their solutions and conclusions are valid by describing the strategies and procedures used and the evidence gathered. They listen to other viewpoints and explanations, and either challenge or accept them.

Thinking, reasoning and working mathematically in this phase of an investigation is exemplified by students:

- describing pathways through the investigation, and giving reasons for the selection of procedures and strategies
- evaluating their own and others' thinking and reasoning
- making connections between prior and new learning
- making generalisations
- reflecting on new learning and describing how it may be applied in other situations
- justifying or debating conclusions based on the strategies and procedures used
- posing similar investigations or problems.

## Teaching framework

This framework enables teachers to develop investigations that promote a thinking, reasoning and working mathematically environment. It supports the design and development of activities through which students can develop the knowledge, procedures and strategies necessary to demonstrate their learning.

