Supporting High Potential and Gifted Learners in Mathematics

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Overview

1.0

- Defining High Potential and Gifted Mathematicians

2.0

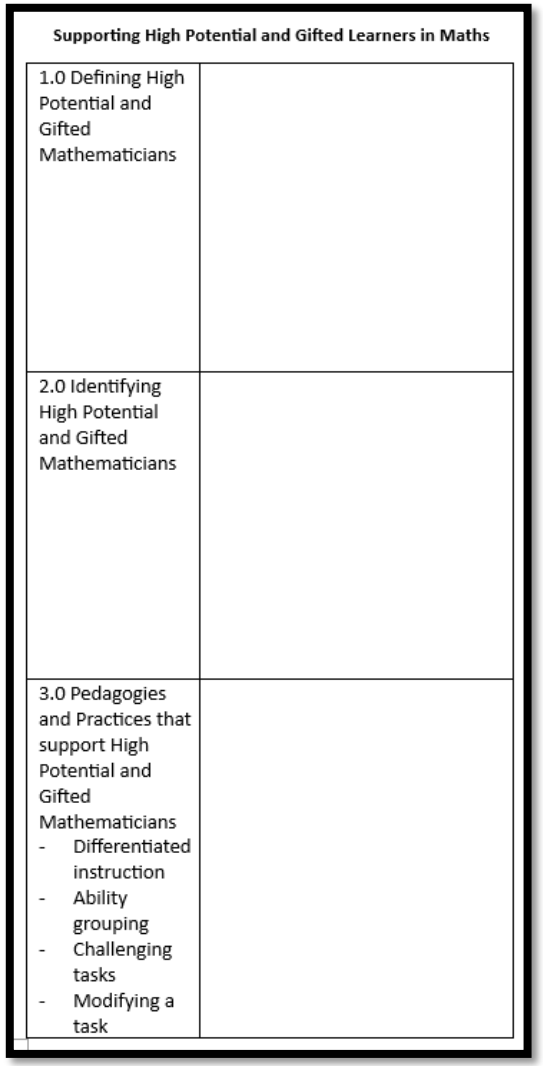
- Identifying High Potential and Gifted Mathematicians

3.0

- Pedagogies and Practices that support High Potential and Gifted Mathematicians
  - Differentiated instruction
  - Ability grouping
  - Challenging tasks
  - Modifying a task

4.0

- Implications



Supporting High Potential and Gifted Learners in Maths

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2.0 Identifying High Potential and Gifted Mathematicians	
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Defining High Potential and Gifted Mathematicians

Defining High Potential and Gifted Mathematicians

There is no universally agreed-upon definition

It is understood that these students exhibit a range of traits that are notably superior to their peers of the same age.

It is difficult to determine the exact number of high potential and gifted and/or talented students in Australian schools.

10% is considered as a reasonable guide

High-ability refers to students whose ability is more advanced than that of similar-aged peers across one or more domains. These domains include:

Intellectual ability: usually manifests in a broad range of academic-focused subjects, speed of learning and complex thinking patterns.

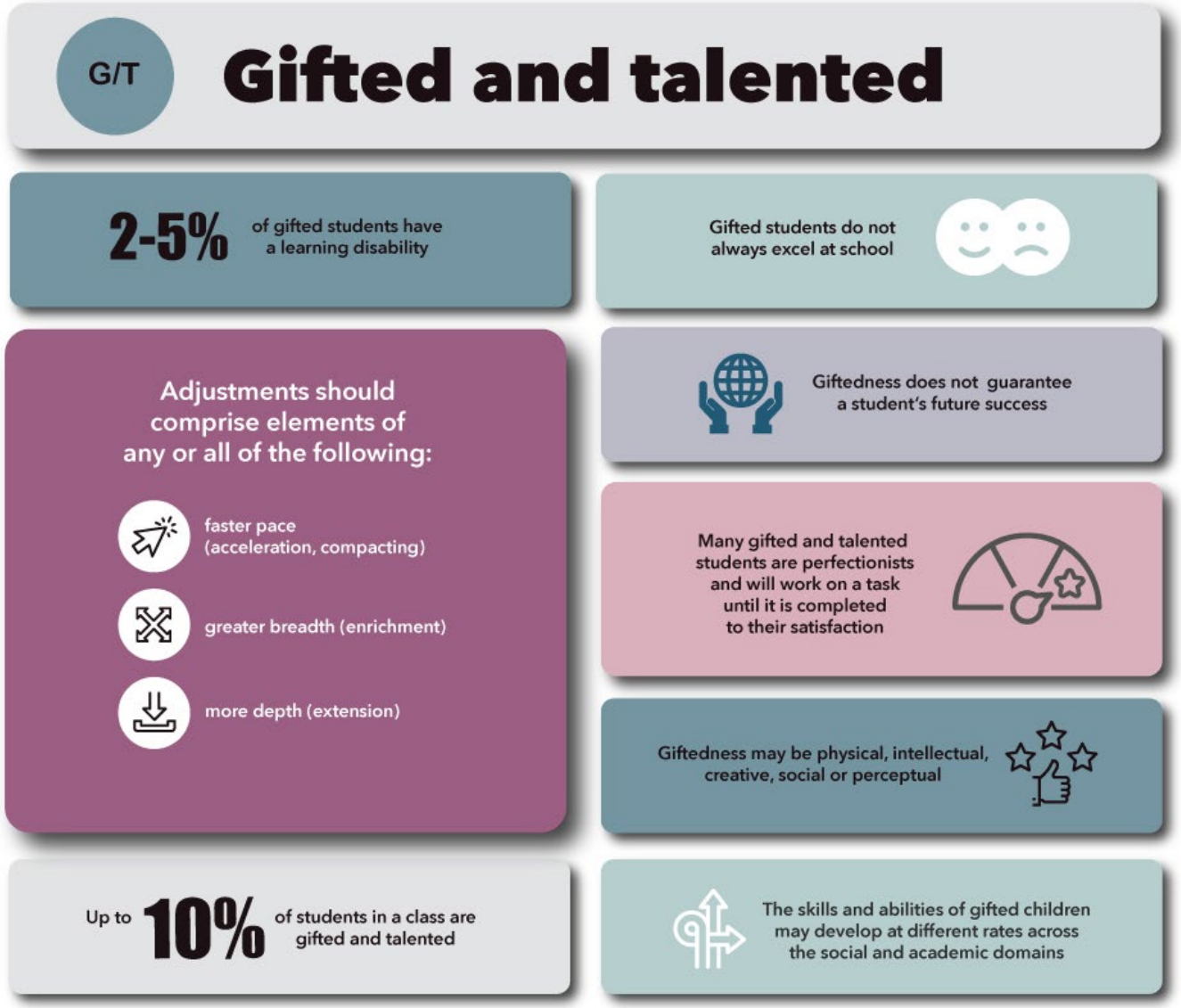
Physical ability: often presents in physical education or dance.

Creative ability: is likely to find expression in the arts.

Advanced social ability: will cut across a variety of subject areas. Often finds expression in leadership.

Australian Curriculum (n.d); Victorian Government (2021)

Defining High Potential and Gifted Mathematicians



Australian Curriculum (n.d)

The Melbourne Declaration (2008)

Each state and territory has processes in place to identify gifted and talented learners and to meet the goals of the Melbourne Declaration.

State and federal education authorities have contributed to inquiries into the education of gifted and talented children.

The submissions have addressed a range of issues, including:

- defining and measuring giftedness
- challenges associated with meeting the needs of gifted and talented students
- current provisions for gifted education
- implications for education policy and administration.

Ministerial Council on Education, Employment, Training and Youth Affairs (2008)

The Alice Springs (Mparntwe) Education Declaration (2019)

Successful lifelong learners who…

- are able to think deeply and logically, and obtain and evaluate evidence as the result of studying fundamental disciplines
- are creative, innovative and resourceful, and are able to solve problems in ways that draw upon a range of learning areas and disciplines and deep content knowledge
- are inquisitive and experimental, and have the ability to test different sources and types of knowledge
- are responsive and adaptive to new ways of thinking and learning
- continue to improve through formal and informal learning in further education, and training or employment, and acquire the skills to make informed decisions throughout their lives
- are able to make sense of their world and think about how things have become the way they are
- are confident and motivated to reach their **full potential**.

Ministerial Council on Education, Employment, Training and Youth Affairs (2019)

10% of students in a class are gifted or high potential

What does this mean for you as a leader and teacher in mathematics?

Francoys Gagné (1998)

Are these terms the same?

High ability	The term high-ability is used to indicate high potential and/or performance across the full suite of human abilities. The term high-ability includes students who: are performing above their same-aged peers; have the ability to perform above their same-aged peers; are accelerated; are twice exceptional.
High potential	High potential students are those whose potential exceeds that of students of the same age. They may benefit from an enriched or extended curriculum and learning opportunities beyond the typical level of their age peers.
Gifted students	Gifted students are those whose potential significantly exceeds that of students of the same age.

Victorian State Government, Defining high-ability (2021); NSW DoE, HPGE Policy Information (2023)

Group task

As a group read the excerpt from a paper

Discuss: *What implications should a teacher consider in response to this information?*

Identify one idea to share

What are the implications?

Characteristics of High Potential and Gifted Mathematicians

- Can generalise quickly
- Can extend, create and invent new methods of soling mathematical problems
- Is naturally strive for the cleaners and most ‘elegant’ path to solve a problem
- Can learn concepts quickly - Sustained high achievement
- Has deep understanding of concepts (working mathematically)
- Can formalise material
- Can reason logically
- Is a flexible thinker
- High mathematical memory
- Can relate concepts
- …?

Implications for you…?

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Identifying High Potential and Gifted Mathematicians

HPGE student identification should be contextually informed, adhering to prevailing models e.g. Gagné's Differentiated Model of Giftedness and Talent

Recognition of giftedness across diverse domains and varying levels is imperative for inclusive identification.

A multi-criteria approach to identification fosters inclusivity and minimises bias, drawing from a range of data sources.

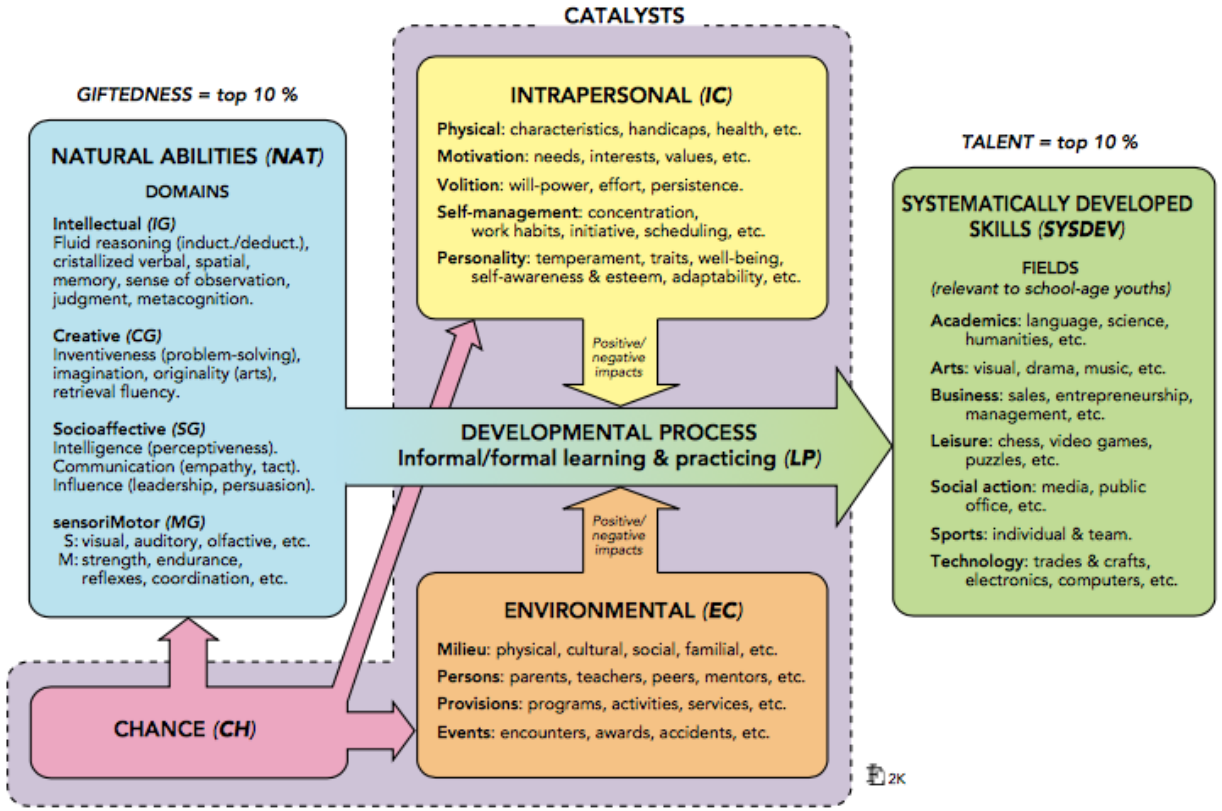
Adequate professional development for teachers/SLOS ensures the effective use of identification instruments.

Validity and reliability of identification instruments are paramount for accurate identification.

Incorporating both objective and subjective instruments offers a comprehensive view of giftedness.

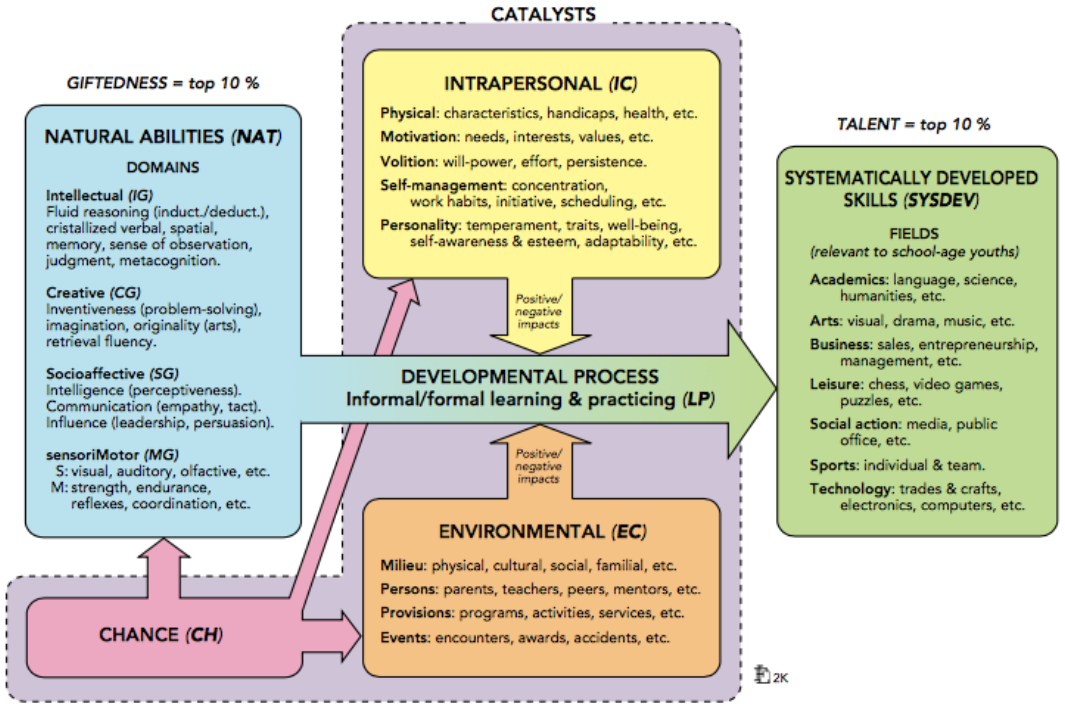
Combination rules for interpreting identification data should align with intended educational interventions.

An ongoing identification process enables the gathering of longitudinal data for accurate assessment of gifted abilities.



Gagné's Differentiated Model of Giftedness and Talent (DMGT.EN.2K)

Theoretical Models



Gagné's Differentiated Model of Giftedness and Talent (DMGT.EN.2K)

Mathematics assessment and identification measures

Assessment and identification practices

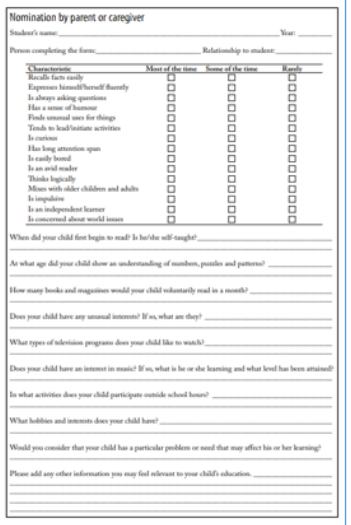
Victorian Government

- Consider the options available and your own school context when making decisions about assessment methods including:
  - ability tests
  - achievement tests
  - adaptive tests
  - rating scales
  - performance-based assessments
  - dynamic assessments
  - growth modelling assessments.
- On enrolment, parents complete a short questionnaire or rating scale that provides information about their child's previous experiences across all domains of ability.
- At key transition points (e.g. pre-school to primary, or primary to secondary) schools share information about students.
- During key transition periods, all students complete a series of screening assessments. These should include a combination of assessments to include all domains which are appropriate to the school context such as:
  - self-assessment rating scale
  - ability test
  - above-level achievement test
  - writing task
  - audition
  - portfolio
  - sport trial
  - group work task.
- This transition information is synthesised and shared confidentially with class teachers.
- Purposeful observation of student behaviour in a range of situations and settings which will enrich teachers' understanding of students' learning needs.
- All student information is regularly reviewed. Students whose assessment information suggests that they may require additional extension, or further learning support, are followed up individually. Where necessary, further assessment can be used to clarify student learning needs.

Slater (2018) has compiled a list of measures that are used in Australian schools to identify high-ability students. These include:

- response to classroom activities
- self-nomination
- peer-nomination
- teacher nomination
- parent nomination
- competition results
- above-level tests
- standardised tests of creative ability
- standardised cognitive assessments (IQ tests)
- observations and anecdotes
- checklists of traits
- interviews (child or parent)
- academic grades.

Subjective tool: Sample Nomination form


Nomination by parent or caregiver

Student's name: _____ Year: _____

Person completing the form: _____ Relationship to student: _____

Characteristic	Most of the time	Some of the time	Rarely
Recalls facts easily	☐	☐	☐
Expresses himself/herself fluently	☐	☐	☐
Is always asking questions	☐	☐	☐
Has a sense of humour	☐	☐	☐
Finds unusual uses for things	☐	☐	☐
Tends to lead/initiate activities	☐	☐	☐
Is curious	☐	☐	☐
Has long attention span	☐	☐	☐
Is easily bored	☐	☐	☐
Is an avid reader	☐	☐	☐
Thinks logically	☐	☐	☐
Mixes with older children and adults	☐	☐	☐
Is impulsive	☐	☐	☐
Is an independent learner	☐	☐	☐
Is concerned about world issues	☐	☐	☐

When did your child first begin to read? Is he/she self-taught? _____

At what age did your child show an understanding of numbers, puzzles and patterns? _____

How many books and magazines would your child voluntarily read in a month? _____

Does your child have any unusual interests? If so, what are they? _____

What types of television programs does your child like to watch? _____

Does your child have an interest in music? If so, what is he or she learning and what level has been attained?

Is what activities does your child participate outside school hours? _____

What hobbies and interests does your child have? _____

Would you consider that your child has a particular problem or need that may affect his or her learning?

Please add any other information you may feel relevant to your child's education. _____

Objective Tools

Individual Ability Assessment by Psychologist/School Counsellor

Wechsler Intelligence Scales for Children Version Five (Wechsler, 2014)
Stanford-Binet Intelligence Scale Version Five (Roid, 2003)

Group Aptitude Assessment by School Counsellor or Qualified Teacher

- Cognitive Abilities Test™ (CogAT®) (Houghton Mifflin Harcourt 2012)
- Otis-Lennon School Ability Tests (Otis & Lennon, 1936, 2004)
- Kaufman Assessment Battery for Children (Kaufman & Kaufman, 2003)
- Slosson Intelligence Test Revised (SIT-R3) (Slosson, 2002)

Group Achievement Assessment by School Counsellor or Qualified Teacher

- Progressive Achievement Tests in Reading and Mathematics (ACER Press, 2013)
- Tests of Reading Comprehension – TORCH 3rd Edition (ACER Press, 2013)

Standardised Achievement Tests designed by educational authorities or schools

- University Competitions e.g. ICAS
- NAPLAN
- Grade based tests
- Off-level tests

Other tools

- Peer and self nomination forms
- Student portfolios and student interest surveys

Design a **Mathematics Assessment and Identification Protocol** for you to take to your teaching and/or leadership team

What are the main themes in your protocol?

Implications for you as a leader and teacher of mathematics?

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Pedagogies and Practices that support High Potential and Gifted Mathematicians

Differentiated Instruction

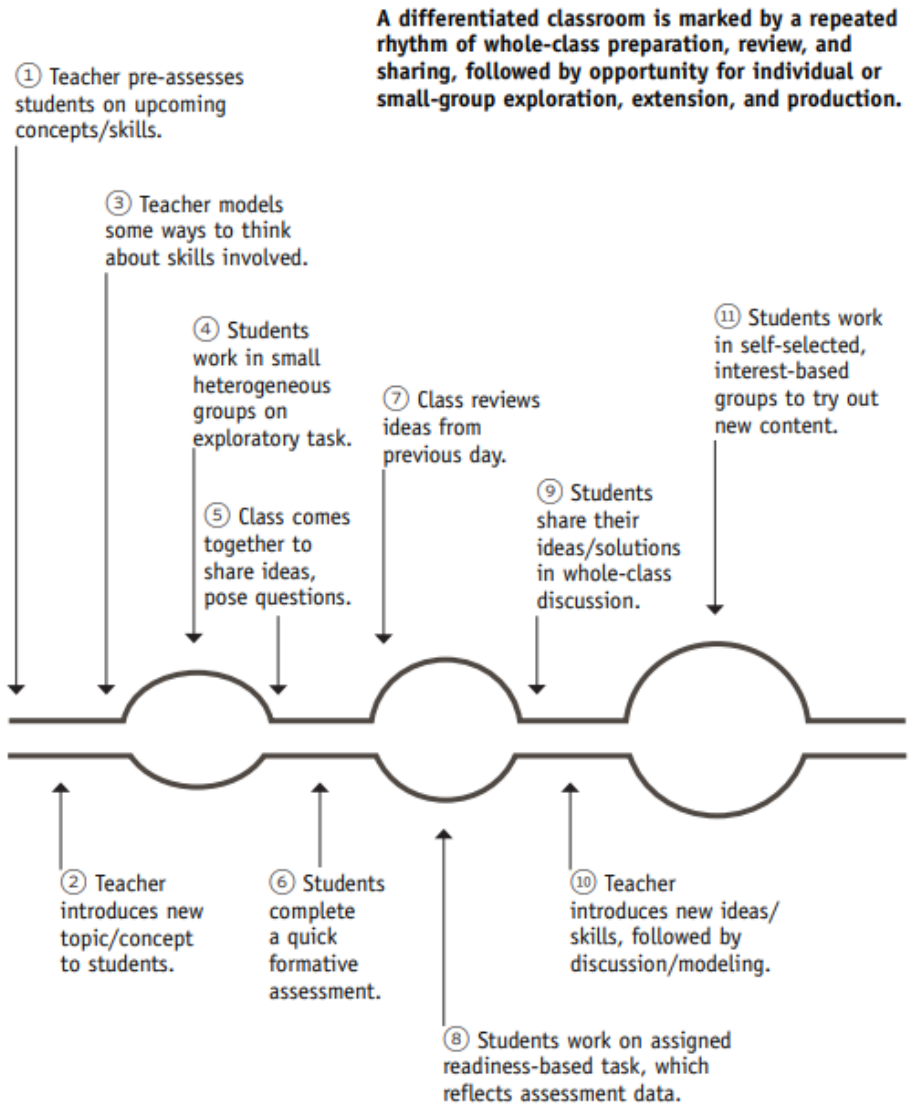
Differentiated instruction is NOT

- individualised instruction
- homogenous grouping
- just for the outliers

Differentiated instruction IS

- proactive
- more qualitative than quantitative
- rooted in assessment
- taking multiple approaches to content, process and product
- student centred
- a blend of whole-class, group, and individual instruction

Figure 1.1 The Flow of Instruction in a Differentiated Classroom



Tomlinson, 2017

Pedagogies that support Gifted and High Potential Mathematicians

Table 4.1. Traditional pedagogy v. differentiated pedagogy

Traditional Pedagogy	Differentiated Pedagogy
Differences are not acknowledged, there is intervention when issues become significantly obvious.	Differences between students are studied and constitute the point of departure of the pedagogical project.
A general comprehension of students' intelligence is predominant.	The multiple forms of intelligence are recognised.
There is a simple definition of excellence in school.	Excellence is defined mostly from the individual evolution in relation with a previous stage.
Students' interests are sometimes taken into account.	Students are frequently solicited in order to base the teaching on their interests and motivations.
Teaching/learning follows the idea of respecting a manual and a curriculum.	Teaching/learning takes into account the availability, interests and profiles of the students.
Teaching/learning is focused on contents and activities not necessarily linked to context.	Teaching/learning is focused on the acquisition of essential skills, in order to value and understand the concepts and relevant knowledge.
In and out of class tasks provide one option only.	Various options are available for in and out of class tasks.
Time management is relatively flexible.	Time is managed in a flexible way, in accordance with the students' needs.
The work is mostly based on written texts.	There are diversified teaching/learning materials.
Facts and ideas tend to have one interpretation.	Facts and ideas tend to have various possible interpretations.
The teacher guides the student's behaviour.	The teacher promotes the acquisition of an autonomous learning ability.
The teacher solves the problems.	Students help their classmates and the teacher to solve the problem.
Student assessment is done mostly at the end in order to verify what was understood.	Student assessment is continuous and repeated in order to adapt the teaching to the students' needs.
Classification is standardised.	The teacher negotiates with the students, defining individual learning goals for the whole class.
One type of assessment is used.	Student assessment methods are diversified.

Note: This table proposed by the Portuguese National Association Study and Intervention in Gifted Education (*Associação Nacional para o Estudo e a Intervenção na Sobredotação*) was translated from Portuguese to English by the author.

OECD Education Working Papers (2021)

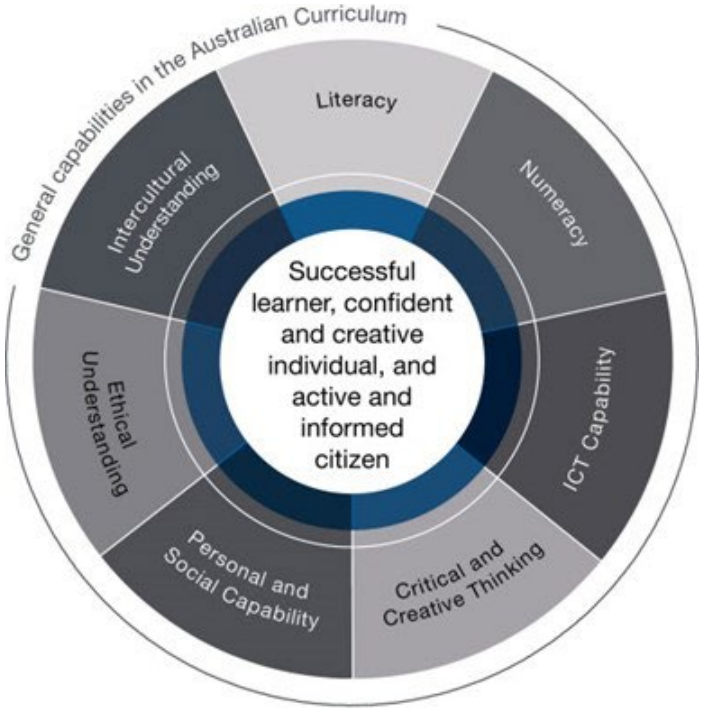
Traditional Pedagogy v. Differentation Pedagogy

Students' interests are sometimes taken into account;	Students are frequently solicited in order to base the teaching on their interests and motivations;
Teaching/learning is focused on contents and activities not necessarily linked to context;	Teaching/learning is focused on the acquisition of essential skills, in order to value and understand the concepts and relevant knowledge;
Facts and ideas tend to have one interpretation;	Facts and ideas tend to have various possible interpretations;
One type of assessment is used.	The teacher negotiates with the students, defining individual learning goals for the whole class;

OECD Education Working Papers (2021)

Proficiencies (Mathematics Version 2.0) and **General Capabilities** (ACARA)

The proficiencies of **Understanding**, **Fluency**, **Reasoning** and **Problem-solving** are embedded in all 6 strands and further the development of increasingly sophisticated knowledge and understanding of mathematical concepts, fluency in representations and procedures, and sound mathematical reasoning and problem-solving skills.



Pedagogy /Practice

- 1: Ability Grouping
- 2: Challenging Tasks
- 3: Modifying a Task

Pedagogy /Practice 1: Ability Grouping

Not all student groupings are the same

We are unsure as to what extent ability grouping is becoming conflated with or embedded in differentiated instruction.

What exactly teachers mean by ability grouping… still need to be investigated.

Ability grouping has long been a controversial practice.

Differentiated instruction has been presented as a positive approach to meet the needs of diverse learners.

Using data for ability grouping and differentiation

Pros	Cons

Using data for ability grouping and differentiated instruction

Pros	Cons
• Data use has been associated with improved student achievement or schooling practices • Data can be a powerful tool to push teachers to challenge assumptions about student ability and reflect on their instructional practices. • Assessment data play a large role in differentiated instruction in the form of student grouping. • Some teachers adopt groupings that are flexible and changed weekly.	• Data can also foster inequity which lead to narrow assumptions about student ability. • Data do not always lead to new interpretations about student ability. • Data are used one time to place students into classes or remediation groups in which they remain for the duration of the year. • Assigning students to homogeneous groups by ability levels also assumes that learning is a linear process requiring the acquisition of discrete skills.

Park & Datbow (2017)

Vic. Gov. Issues in the Teaching of Mathematics, Ability Grouping

Take Out

There is no evidence from research studies that ability grouping *between* classes (i.e., streaming or regrouping) is associated with improved mathematics learning outcomes for all students. However, there is evidence that the longer students remain in ability groups, the greater the achievement gap between lower and higher-attaining students becomes.

Take Out

The opportunity to learn mathematics in mixed-ability classes leads to better cognitive and social outcomes than learning mathematics in classes grouped by ability (i.e., streamed or tracked classes).

Take Out

There is no evidence from research syntheses and meta-analyses to suggest that *between* class ability grouping (i.e., streaming/tracking) is associated with improved mathematics achievement. While small positive achievement benefits have been reported for gifted students undertaking specialist programs and for *within* class ability grouping under certain conditions, the research that underpins these two claims tends not to consider the impact of ability grouping on students' self-confidence, efficacy, or long-term social standing.

Take Out

Lower and middle-attaining students achieve more in mixed ability classrooms than they do in *between* class ability groups (i.e., streamed classes). Higher attaining students appear to do equally well in either classroom organisation.

Take Out

Small, flexible groups formed for the purpose of addressing an important, specific, shared learning need can be highly effective in improving student mathematics outcomes particularly where the teaching is informed by reflection and feedback.

What does this mean for you, your school context…?

Victorian Government, Issues in the Teaching of Mathematics, Ability Grouping (2022)

Pedagogy /Practice 2: Challenging Tasks

First

Challenging tasks facilitate the development of cognition → through high level thinking and reasoning

Second

Challenging tasks support the use and development of metacognition skills → knowing when to use certain mathematical knowledge

Third

Challenging tasks increases motivation → self-efficacy and self-esteem is heightened

Fourth

Challenging tasks facilitate autonomy → through rich and challenging problem solving and open ended possibilities.

Diezmann & Watters (2000)

Story of Practice

Grade 1

At a party five people met for the first time. They all shook hands with each other once. How many handshakes were there altogether?

Diezmann & Watters (2000)

Jamie's diagram

4
3
2
1
10

Figure 1
Five People Shake Hands

Diezmann & Watters (2000)

The task was too easy for Jamie.

What would you do to make this task more challenging?

Jamie was asked to calculate the number of handshakes for six people.

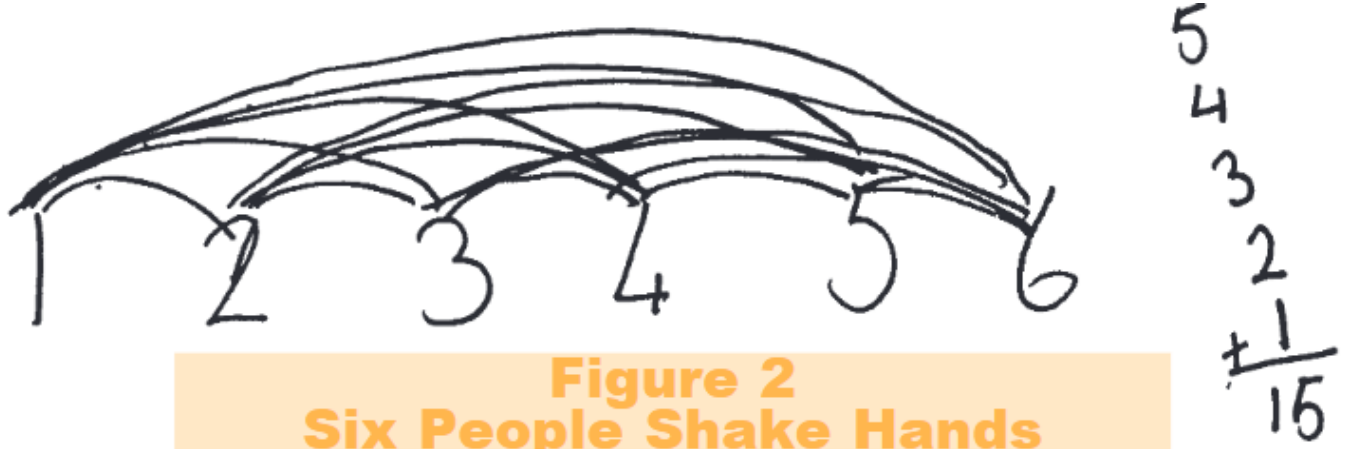


Figure 2
Six People Shake Hands

Diezmann & Watters (2000)

Jamie then asked how many handshakes there would be if 100 people each shook hands with one another

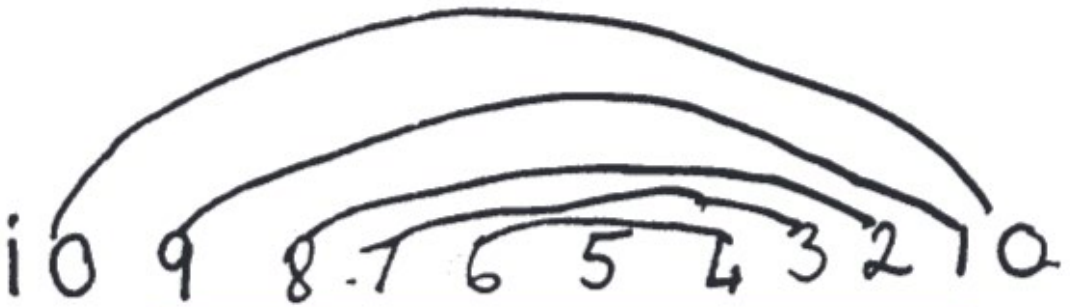


Figure 3
Rainbow Tens

Diezmann & Watters (2000)

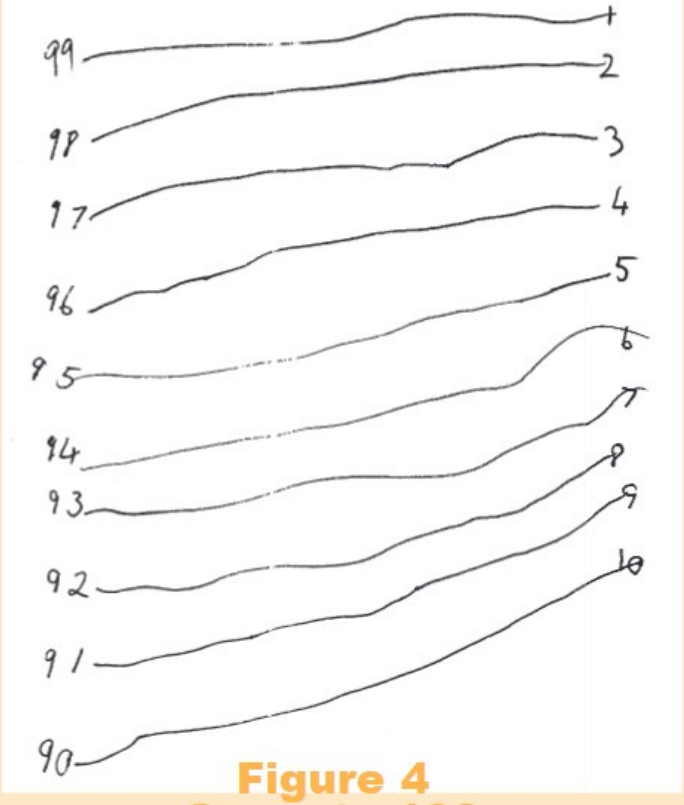


Figure 4
Sums to 100

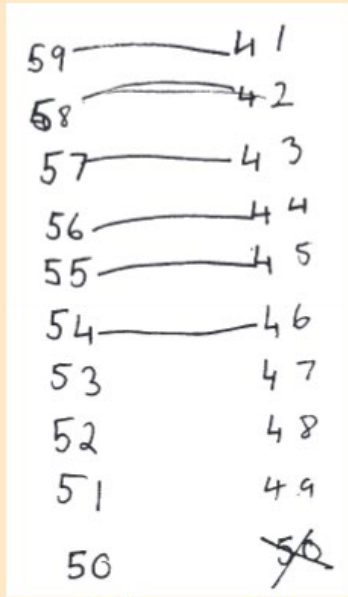
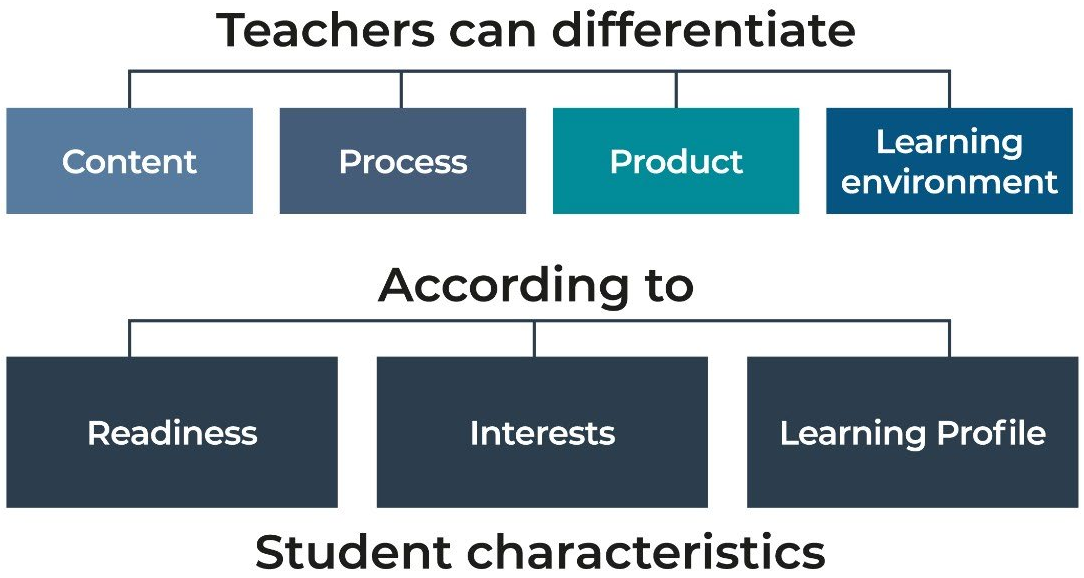


Figure 5
Excluding the second 50

Diezmann & Watters (2000)

Pedagogy /Practice 3: Modifying a Task

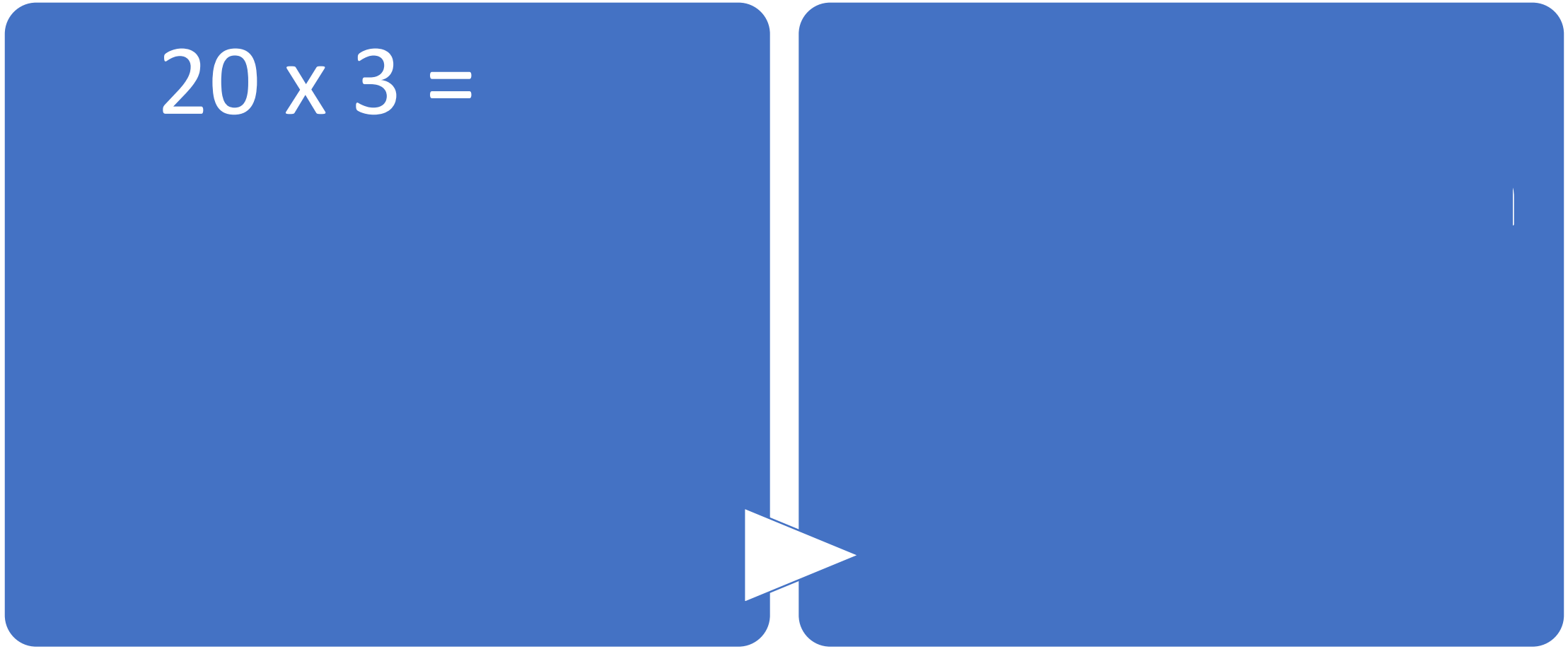


NSW DoE – Differentiated Learning, 2024; Tomlinson, 2017

More than one answer

(with pattern blocks)
How many triangles fit on the trapezoid?

Working backwards



Multi-Step

One egg carton holds 12 eggs. How many cartons are needed for 187 eggs?

Writing worded problems

$2 \div 1/2$

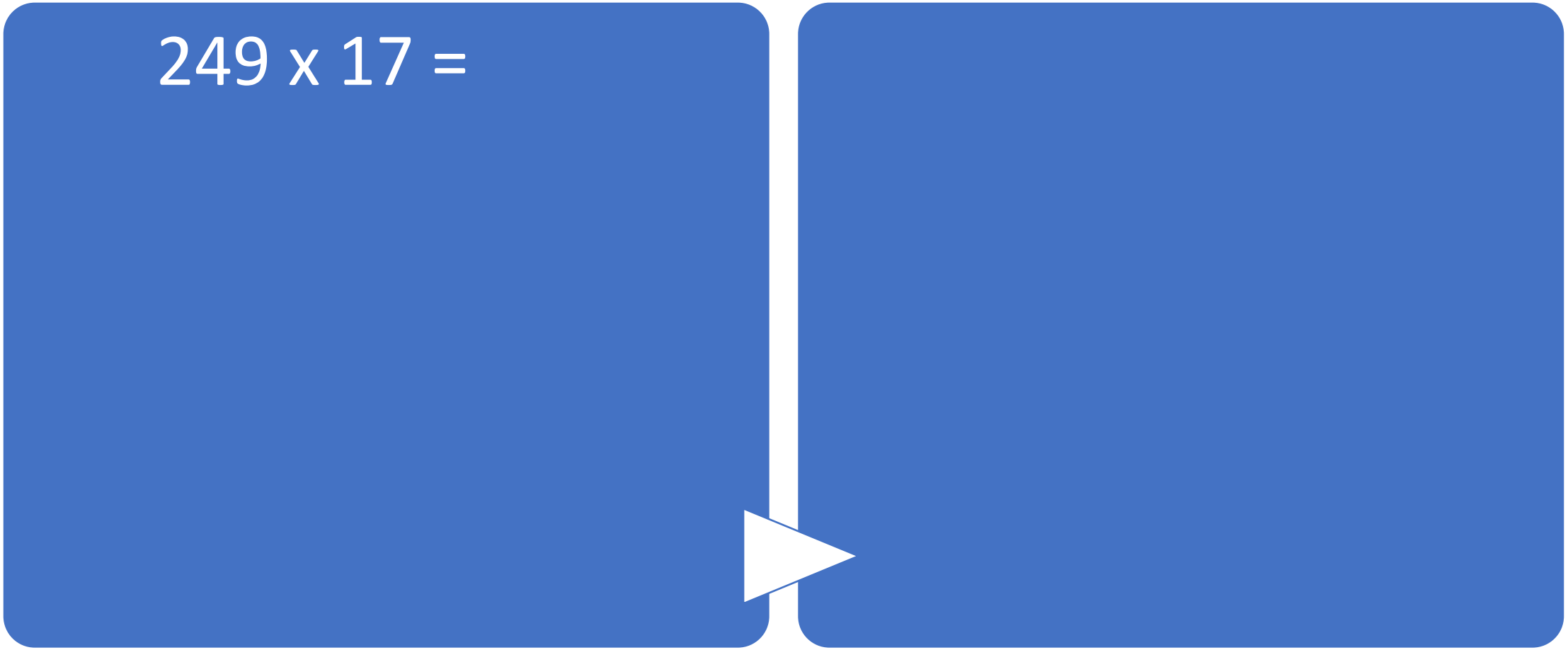
Generalise

Circle the even numbers:

2 5 10 17 21 30

Open-ended questions

249 x 17 =



Provide justifications

Which is more?

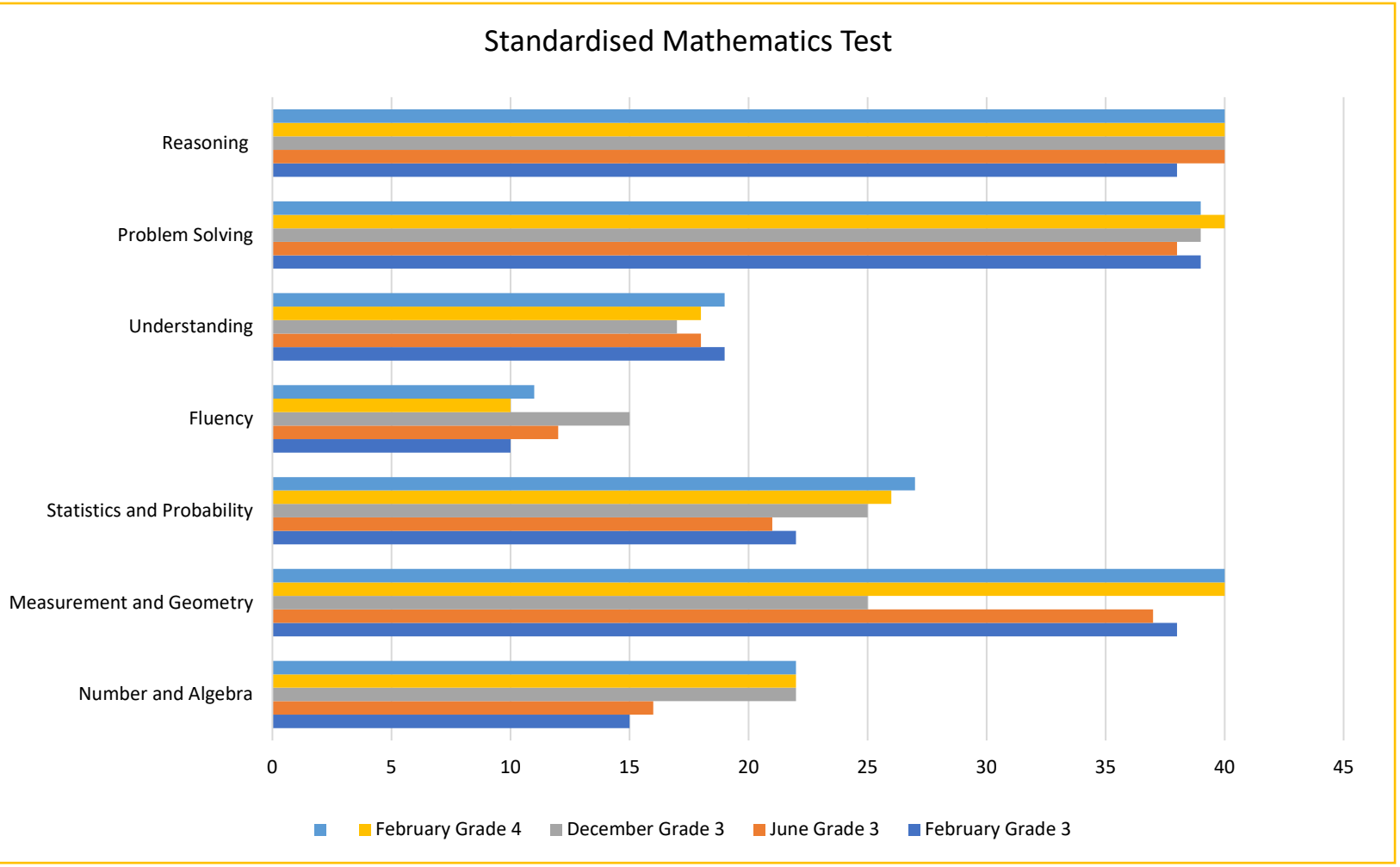
$\frac{4}{7}$ $\frac{7}{8}$

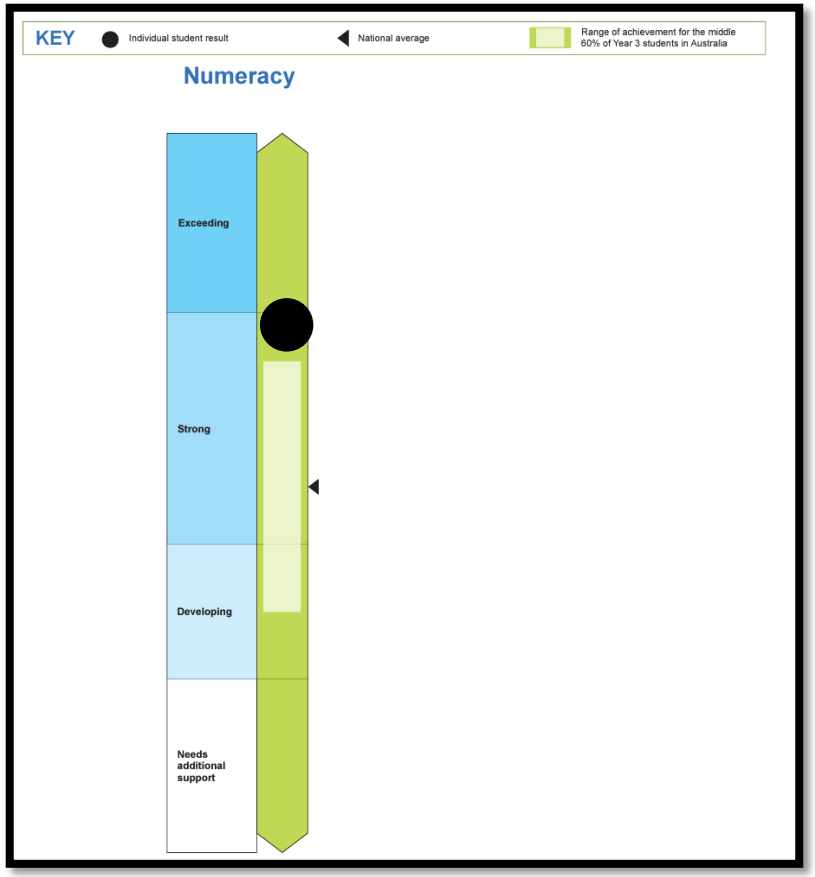
Scenario

- Meet Jay, a student in Grade Four, brimming with creativity and natural leadership.
- While he excels in imaginative expression and captivating his peers with stories inspired by his cultural heritage, Jay also demonstrates surprising mathematical thinking for his age.
- However, despite his advanced mathematical thinking abilities, Jay lacks a solid grasp of foundational mathematical content.

When Jay was presented with the below task, he used real life application

Task: How many ways can you find half of a third?





Unpack scenario

What do you already know?	What more do you need to know?	How do you support your mentee?	What pedagogies/ practices will you implement?	Other

Implications for you as an APC&I?

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thank
you

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