Keeping the Passion Alive: Identifying and Catering for Mathematically Gifted Students

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Characteristics of mathematically gifted students

- Able to reason analytically, deductively and inductively

- Able to abbreviate mathematical reasoning

- Flexible, reversible mental processes

- Energy and persistence

- Mathematical perception of world

(House)
Indicators of mathematical giftedness

- Ability to grasp structure of problem
- Ability for logical thought
- Memory for mathematical relationships
- Mathematical cast of mind

(Krutetskii)
Not indicators of mathematical giftedness

Computational ability

Memory for mathematical formulas
Expertness in problem solving is an overriding feature of mathematically gifted students.
Identification of mathematically gifted students

- Problem solving
- Self nomination
- Peer nomination
- Test results
- Teacher nomination
- Parent nomination
Teacher nomination

Provide opportunities for students to show what they are capable of

Remember – *challenge* and *choice*

Provides both identification and teaching opportunities

Consider – range of problems including open ended problems
The answer is 20 – what is the question?

- $1+1+1+1+1+1+1+1+1+1+1+1+1+1+1+1+1 = 20$
- $100 - 80 = 20$
- $\frac{1}{2} \times 40 = 20$
- $\frac{1}{5} \times 100 = 20$
- 5% of 400
- $40 - 30 \times 2 = 20$ (Teaching opportunities)
Ravi’s castle

Ravi has designed plans for a castle that show the front, top, and side views.

Build a castle to Ravi’s design using the cubes.
What is the largest number of cubes that you can use in the construction of a castle from Ravi’s plans?
What is the smallest number of cubes that you can use in the construction of a castle from Ravi’s plans?
Can you build a symmetrical castle that is different from any of the ones you have built so far? How many symmetrical castles can you build to Ravi’s specifications?

http://nzmaths.co.nz/problem-solving
Problem solving

Sarah went to the shops and bought 4 magazines; Metro, the Listener, More and the New Zealand Woman’s Weekly. In how many different orders can she read her magazines?
Some solutions

By alphabetical order

Worst – favorite, favorite – worst

One at a time or if she has a friend over and they cooed red one as well

16 different ways because you just do 4x4 and you have your answer
A more mathematical solution

M, WW, Me, L
M, WW, L, Me
M, Me, WW, L
M, Me, L, WW
M, L, Me, WW
M, L, WW, Me  = 6
6 x 4 = 24
Problem

Tim’s neighbours have just moved to another town. The new neighbours will arrive next week. Tim has discovered that two of the new neighbours are children. He wonders what the chances are that at least one of the children will be a boy. What do you think?
Some solutions

There might be a chance but he has to find out

The chances are one in a million because its like a coin toss you only know on that when you are cheating

Half a chance

I think the chances are two
A more mathematical solution

BB, BG, GB, GG. \(\frac{3}{4}\) or 75%
Problem

If I add a father’s age to that of his son’s the total is 50 years. The father is 28 years older than the son. How old is the father and how old is the son?
Possible solution methods

Guess and check

Algebra

Tim’s method
GaTE register and tracking

Establish starting point (above level testing)

Track progress

Review at end of each term/year
Provision: Gagné (DMGT 2.0)
Environmental catalysts: Classroom environment
Environmental catalysts: Provision

Grouping
Online learning
Personal pathways

Celebrating success – personal bests
Environmental catalysts: People

Mentors

Roll models

Like minded peers
Working with mathematically gifted others provides opportunities for …

Collaboration

Confrontation

Affirmation

Socialisation
Environmental catalysts: Events

Competitions – group and personal

Online modules eg Coursera
Introduction to mathematical thinking

School math typically focuses on learning procedures to solve highly stereotyped problems. Professional mathematicians think a certain way to solve real problems, problems that can arise from the everyday world, or from science, or from within mathematics itself.

The key to success in school math is to learn to think inside-the-box. In contrast, a key feature of mathematical thinking is thinking outside-the-box – a valuable ability in today’s world. This course helps to develop that crucial way of thinking.
Intrapersonal catalysts: Motivation

Novel work
Challenging work
Choice
Opportunities for prolonged work
Making mistakes – working through ‘the dip’
Self management

Goal setting – short/long term
Time keeping
Organisation
Negotiating work
Appropriate level and pace
Developmental process

Subject specific knowledge and skills

Intellectual and creative challenge

Working like a mathematician
Mathematical knowledge and skills

Mathematical terms
Mathematical notation
Estimation
Checking/proving
Diagrams, flow charts, graphs
Problem solving
Specific areas – e.g. statistics, geometry
Suggestions

What do they know already?
What do they need to know to progress?
Using the teachable moment
Learning from each other
Focus on method used to reach solution
Hints

Keep instruction to a minimum

Provide choice whenever possible

Encourage sharing solutions

Be open to different approaches
Intellectual and creative challenge

Pace up
Repetition down
Challenge high
Freedom to experiment
Focus on creativity, thinking, pushing the boundaries
Acceleration
Working with others of like ability
Usual approach....

12 + 14 + 166 = 242

27 + 34 = 61
Different approach…

How many possible solutions?

13
+ ___
  2___
Practicing adding two digit numbers

\[
\begin{array}{ccc}
16 & +23 & 45 \\
+23 & +34 & +14 \\
74 & 41 & 65 \\
+26 & +39 & +16 \\
\end{array}
\]
A different approach

Take any 2-digit number. Reverse the digits to make another 2-digit number. Add the two numbers together.

How many answers do you get which are still 2-digit numbers?

What do the answers have in common?
Characteristics of 3D Shapes

How many lines of symmetry are there in each of these 3D shapes?
Brian, Margaret, Kim and Jo were all looking at the shapes below.

![Shapes](https://via.placeholder.com/150)

Brian says, "Hey, the first one is the odd thing out."
Margaret says, "No, Brian, the second one’s the odd thing out!"
Kim says, "No, it’s the third one!"
Jo says, "Well you are ALL wrong! The last one is clearly the odd thing out."

Who is right and why?
This site supports schools, teachers, students and parents in assisting gifted and talented students to reach their full potential academically, emotionally, and socially. It provides principles and practices to support identification, planning and education of gifted and talented students. It also provides ongoing professional learning and support for gifted and talented communities.
Mathematics and Statistics

Resources

New Zealand resources
- AIMS University of Canterbury acceleration programme
- Gifted maths education teacher resources: University of Otago
- Mathematical Digest
- MAX University of Auckland acceleration programme
- New Zealand Association of Mathematics Teachers (NZAMT)
- NZAMT Development Band
- NZAMT Junior Enrichment Programme
- NZMaths high achieving students section
- ScholarNET: Junior maths online
- ScholarNET: Senior maths online
- Teacher resources: University of Otago

International resources
- Babylonian Maths
## Car racing

<table>
<thead>
<tr>
<th>Learning Sessions</th>
<th>Description</th>
<th>File Size</th>
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<tbody>
<tr>
<td></td>
<td>Learning session one - One revolution - exploring how far a car wheel travels in one revolution and the number of revolutions for a journey (PDF, 105 KB)</td>
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<tr>
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<td>Learning session two - Ramp rolling - exploring how far a car travels when rolled down a ramp onto different surfaces (PDF, 119 KB)</td>
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<td>Learning session three - Wind me up - exploring distances travelled and speeds of wind up cars (PDF, 103 KB)</td>
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<td>Learning session four - Slot car racing - exploring turning angles in slot car tracks (PDF, 137 KB)</td>
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<td>Learning session five - Drag racing - exploring reaction times (PDF, 195 KB)</td>
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Level 4 Problems

The problems have been grouped below by Strand.

Teaching material

Geometry
- Carries First Cubes
- More of Carries Cubes
- Noughts
- The Castle
- Robots
- Castles on the ground
- The Clumsy Tiler G

Measurement
- Moanas Watch
- Garry the greengrocer
- How Far
- Fertiliser
- Chicken run
- Peter's String

Statistics
- Pennys Pizza
- Bubblegum
- Dominoes
- The Clumsy Tiler S

Number
- Tennis and golf
- How High
- Free Cell
- Fuel Saving
- Eights
- The Clumsy Tiler N

Algebra
- Topsy Turvy Twins
- Pauls patterns
- Owik Qure
- Take 3 or less
- Farm Sheep II
- Still More Lollies

Problem Solving
- Problem Solving Information

Level 1 Problems

Level 2 Problems

Logic and Reasoning
- Brian's Pegboard II
- More No Three In a
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Noughts

In the game of Noughts, each player takes a turn to place a nought on the board (see below). Each new nought goes into a new square. The winner is the first person to place three noughts in a row. Is it possible for either the first player or the second player, to always win? (Assume that each player plays to win and plays as well as is possible.) If so, what is the winning strategy? If not, why not?
Download and Print the Challenges

1. **Line Up!**  
   How long do you have to stand in line?

2. **Beating Heart**  
   How fast does your heart beat?

3. **Popcorn**  
   Which shape holds the most popcorn?

4. **Don't Fall In**  
   Why aren't manhole covers square?

5. **Upside Down?**  
   What letters can be read the same upside down as right-side up?

6. **Which Way?**  
   How many different ways are there to get to your destination?

7. **Double Or Not**  
   Which sequence grows the fastest?

8. **Stamps**  
   Can you combine the stamps to make $1.77?

9. **Mirror, Mirror**  
   Does backing up show more of me?

10. **What's My Angle?**  
    Do bigger hands have larger angles?
Thank you!

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http://gifted.tki.org.nz/