THE MATHEMATICAL ASSOCIATION OF VICTORIA

MAKING + CONNECTIONS

MATHEMATICS NUMERACY

5-6 DECEMBER

#MAVCON

Annual Sponsors

anzuk.education

CAMBRIDGE UNIVERSITY PRESS

CASIO EDU

www.casio.edu.shriro.com.au

TEXAS INSTRUMENTS

THE MATHEMATICAL ASSOCIATION OF VICTORIA

MAKING + CONNECTIONS

MATHEMATICS NUMERACY

5-6 DECEMBER

#MAVCON

KEYNOTE PRESENTATION

Panel Discussion

What's up with secondary school mathematics, and how can we improve it?

THE MATHEMATICAL ASSOCIATION OF VICTORIA

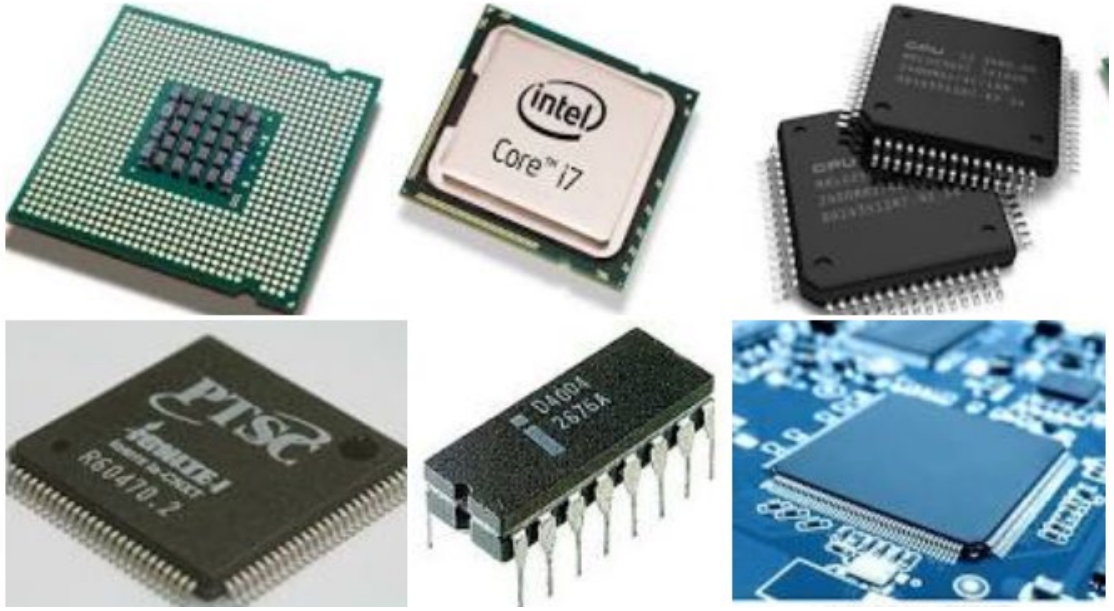
KEYNOTE PRESENTATION

Kylie Slaney
Mathematics and Digital Technologies Teacher
Carey Baptist Grammar School
kylie.slaney@carey.com.au

Panel Discussion

What's up with secondary school mathematics, and how can we improve it?

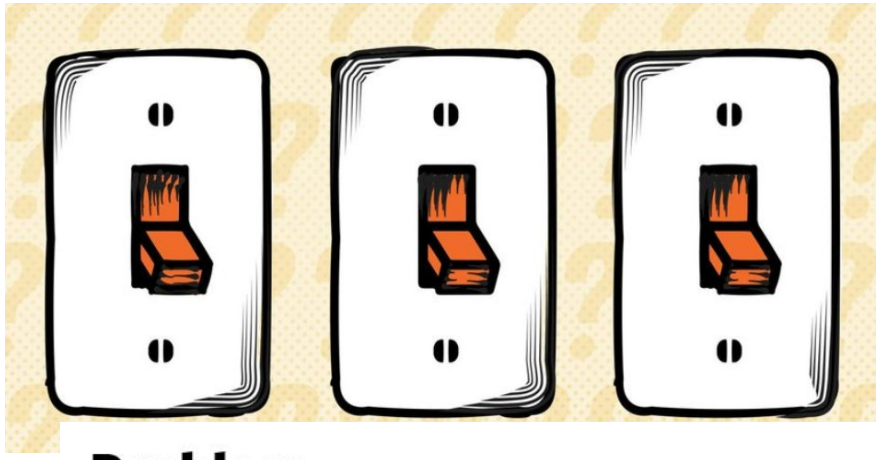
THE MATHEMATICAL ASSOCIATION OF VICTORIA



Thinking versus Doing

One Method One Answer

Application of Suitable Algorithms



THE MATHEMATICAL ASSOCIATION OF VICTORIA

Problem

There is a lightbulb inside a closet. The door is closed, and you cannot see if the light is on or off through the door. However, you know the light is off to start. Outside of the closet, there are three light switches. One of the switches controls the lightbulb in the closet. You can flip the switches however you want, but once you open the door, you can no longer touch the switches.

How do you figure out without a doubt which switch controls the light?

70 / 30

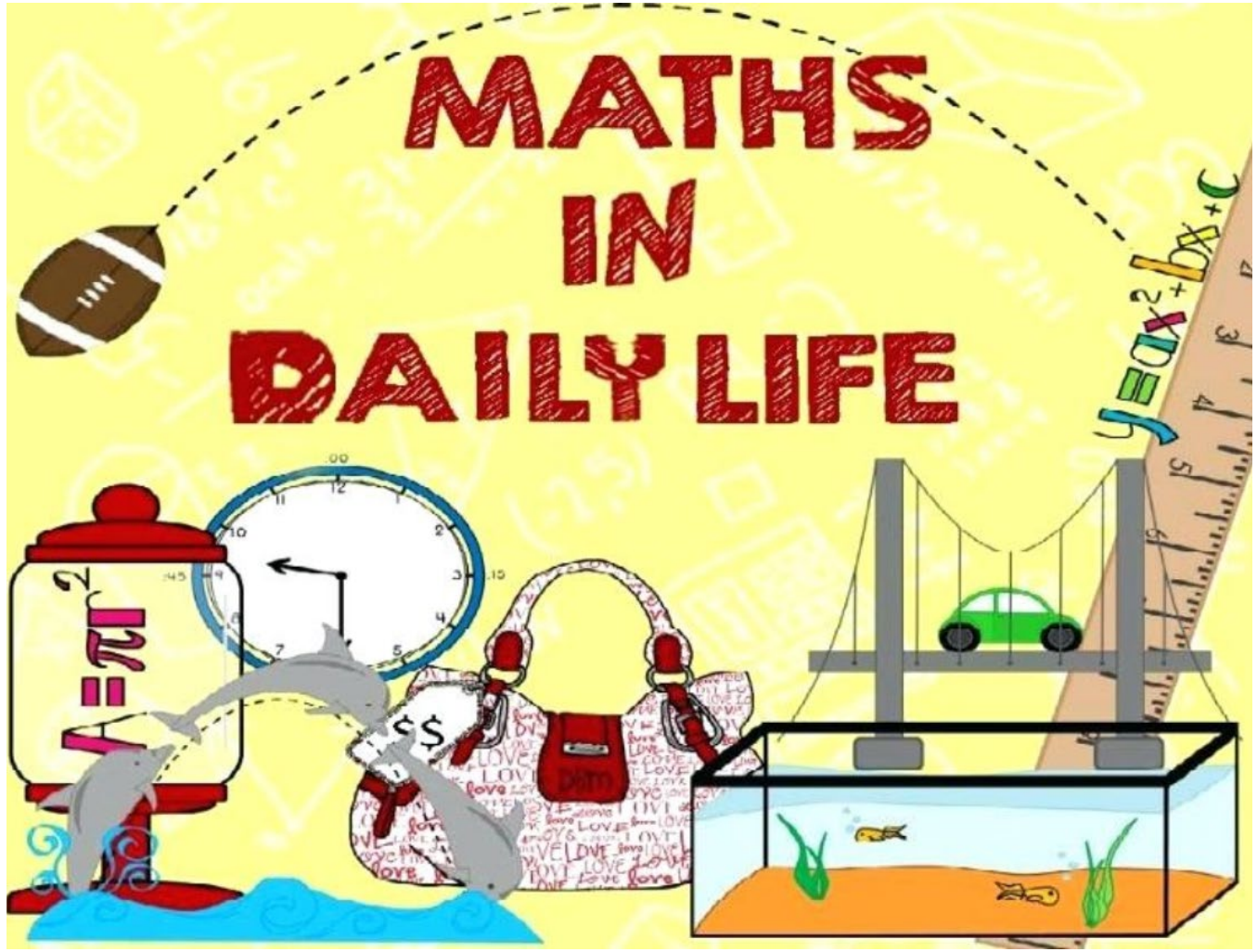
80 / 20

ATAR

Critical Thinking

How many apples can you put in an empty box?

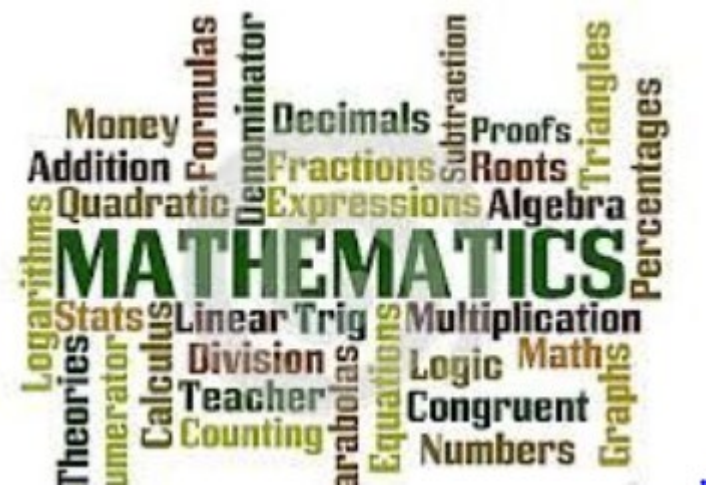
THE MATHEMATICAL ASSOCIATION OF VICTORIA

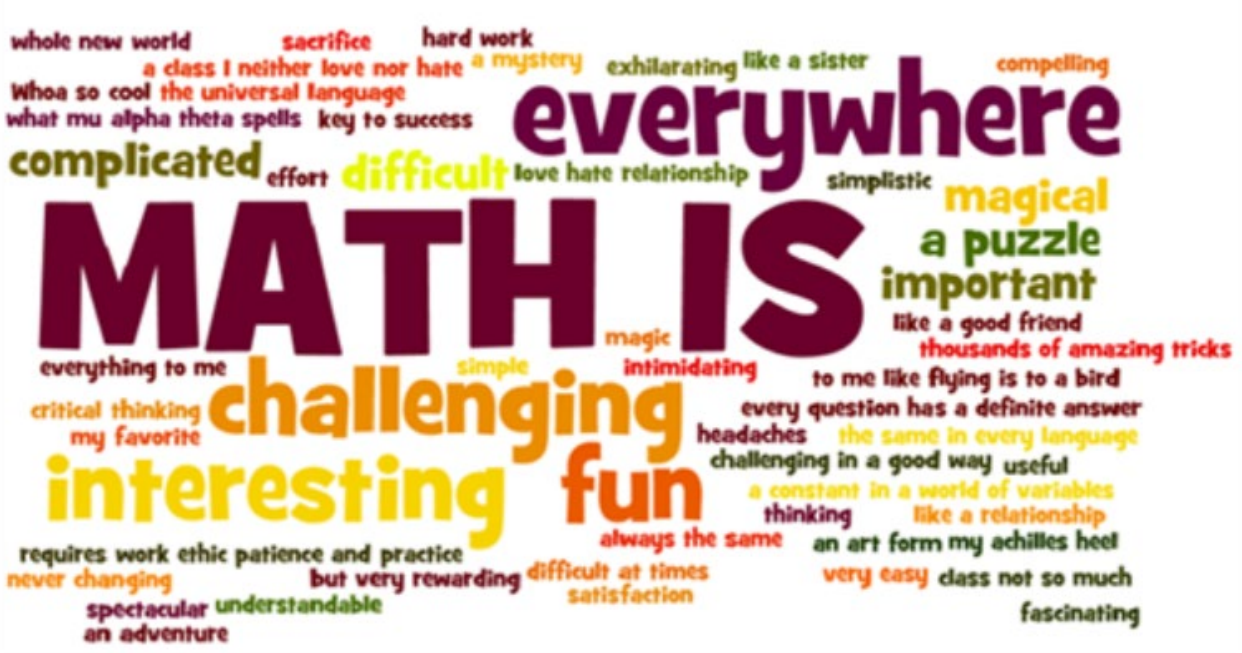


Real Life?

Life Context

World Context





THE MATHEMATICAL ASSOCIATION OF VICTORIA

Underlying skills develop in math classroom

- taking risks
- thinking logically
- solving problems

Last a lifetime

Solve work-related problems

Solve world problems

THE MATHEMATICAL ASSOCIATION OF VICTORIA

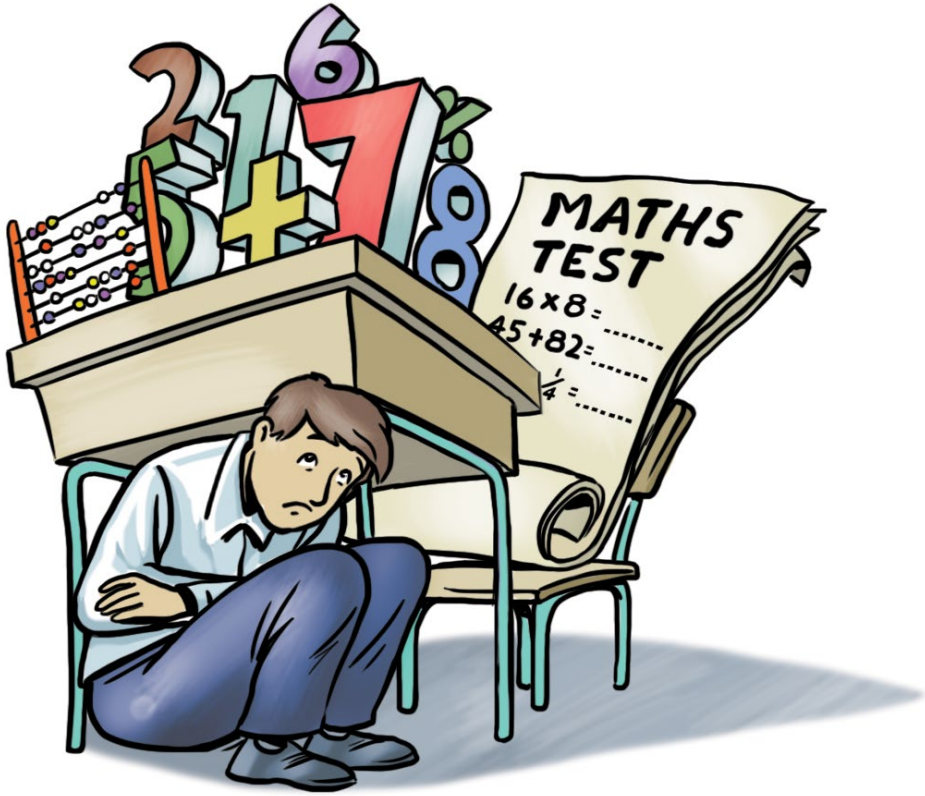
KEYNOTE PRESENTATION

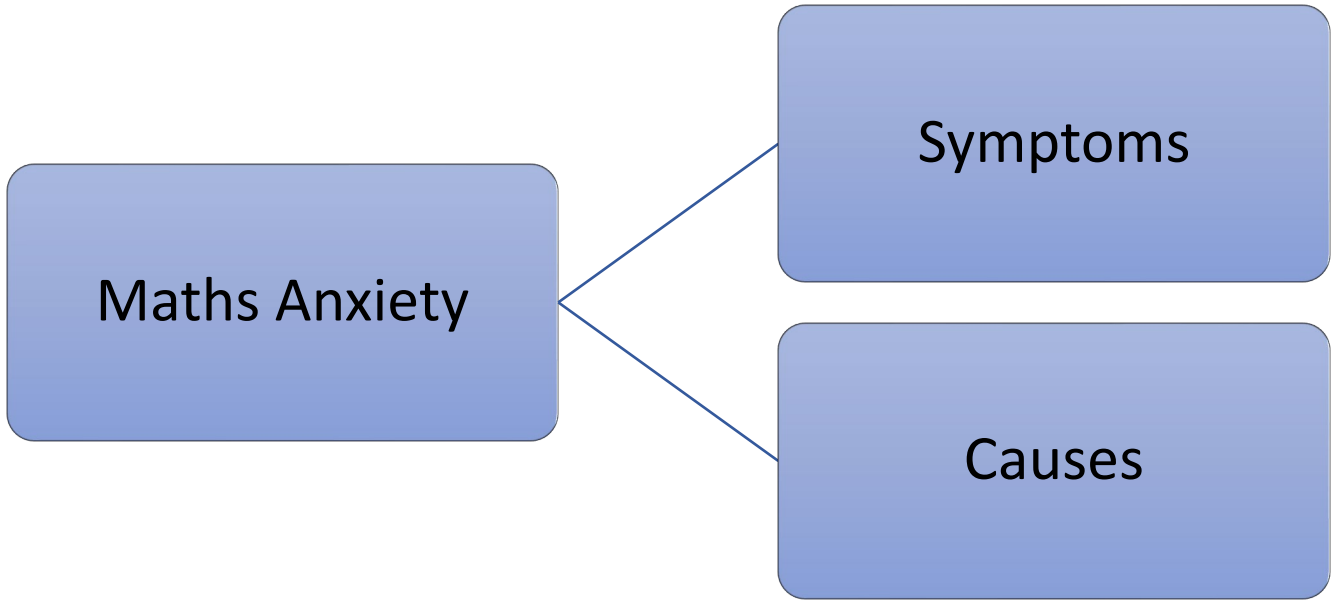
Sarah Buckley
Senior Research Fellow
ACER
sarah.buckley@acer.org

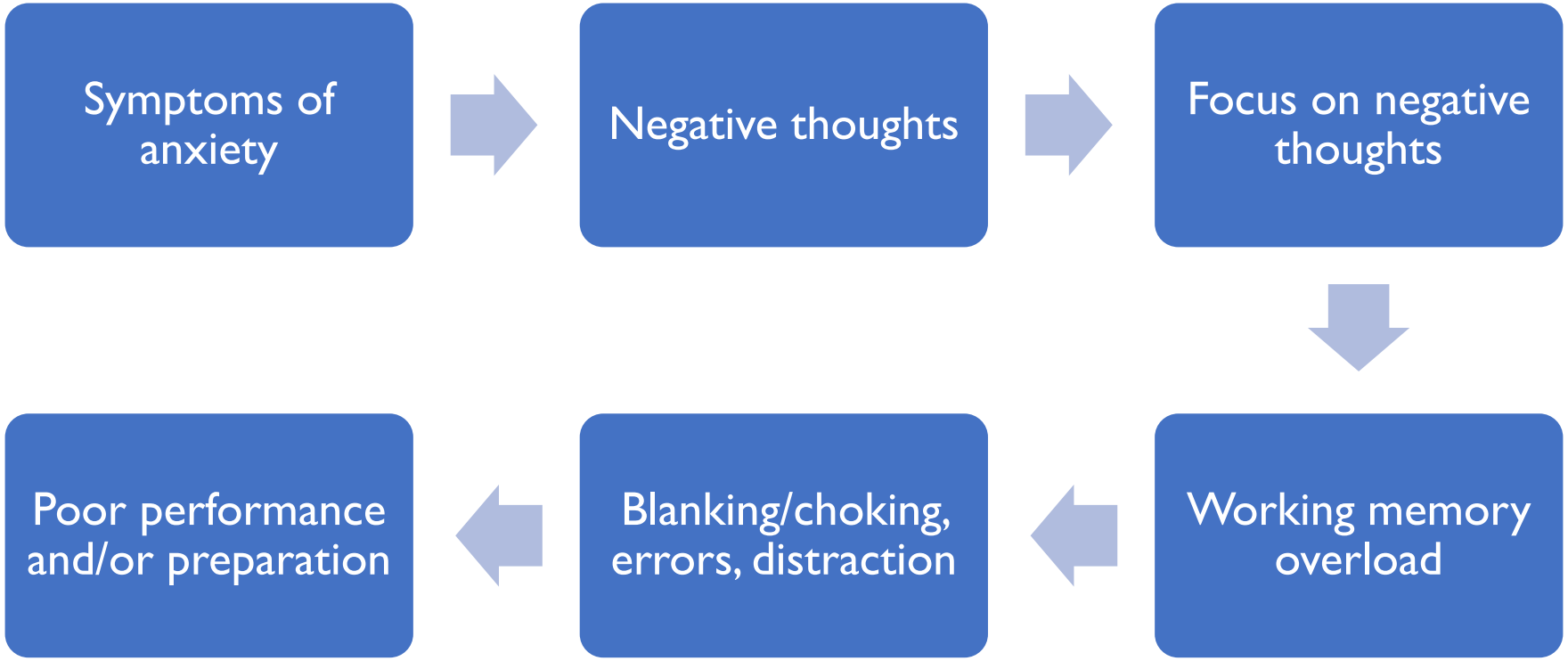
Panel Discussion

What's up with secondary school mathematics, and how can we improve it?

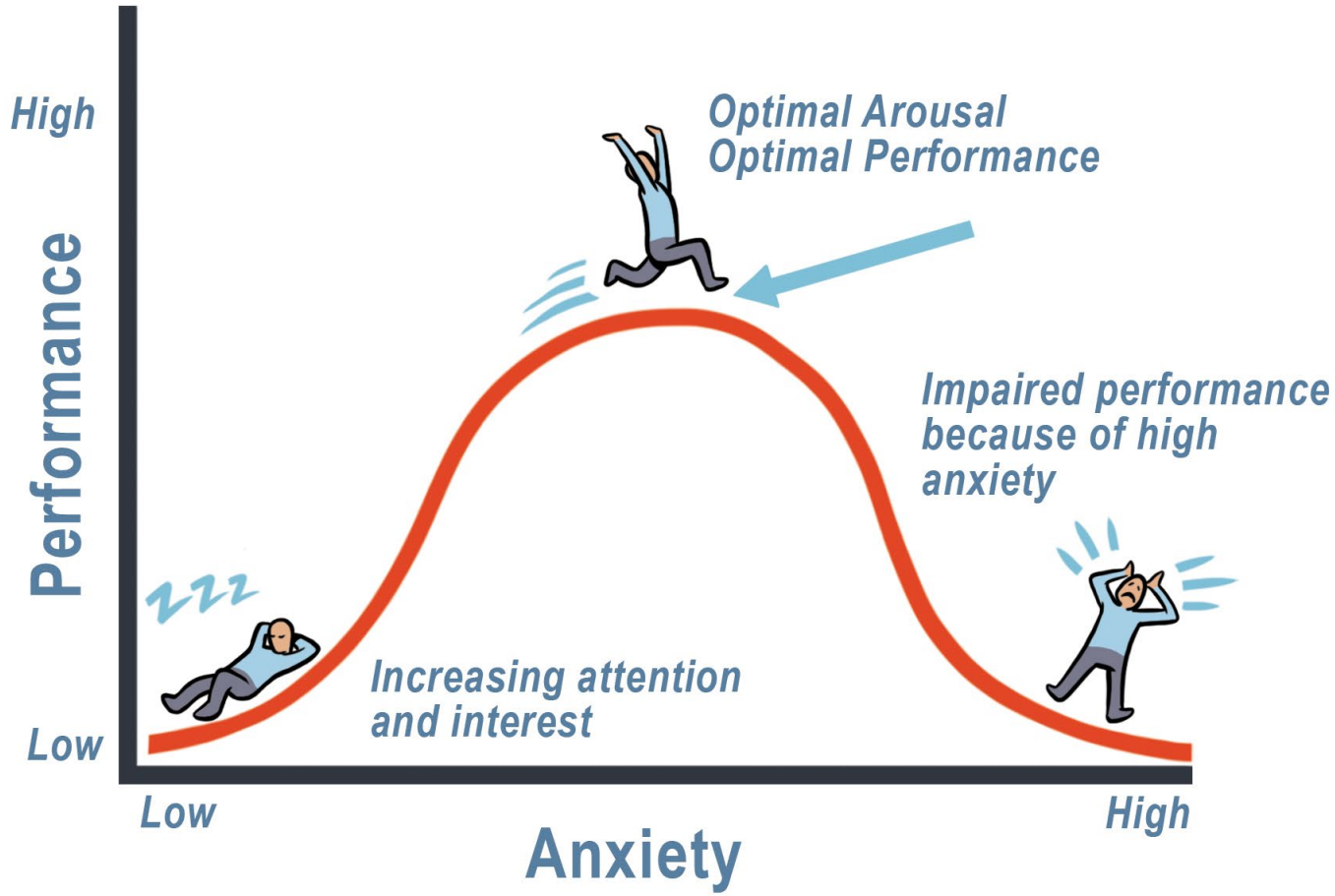
Maths anxiety



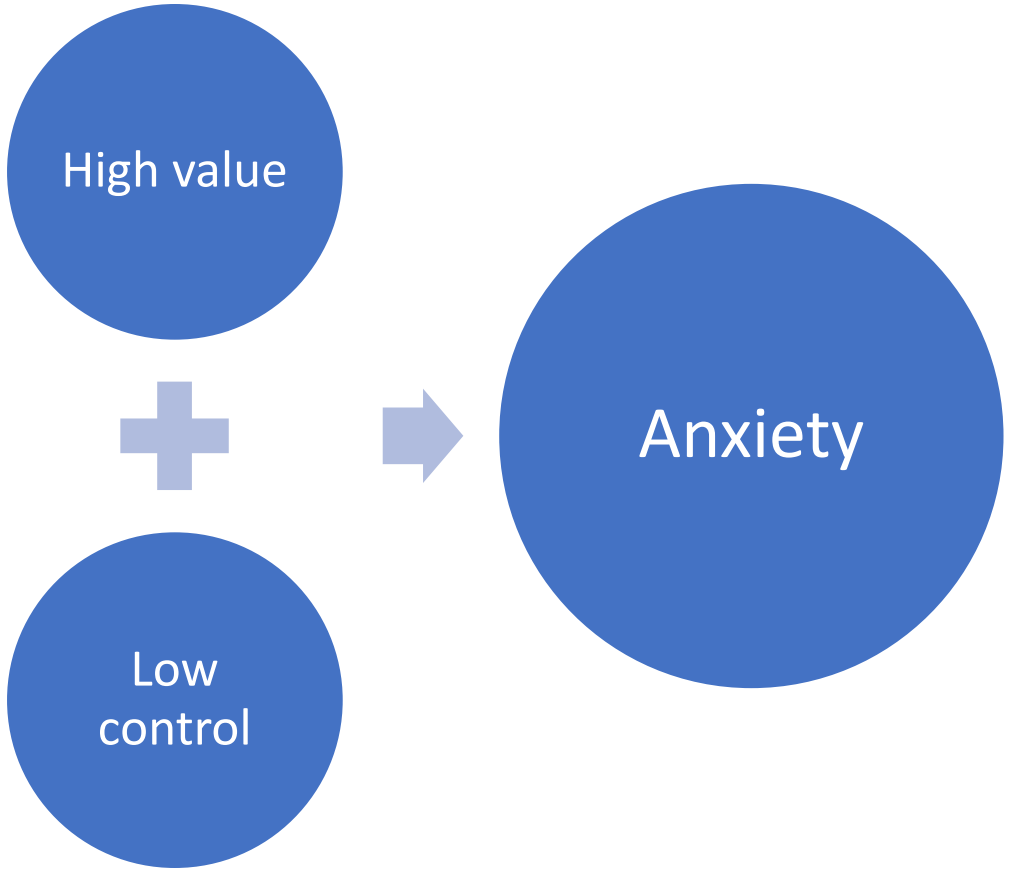

Maths Anxiety
Symptoms
Causes



Ashcraft & Kirk, 2001


High
Performance
Low
Optimal Arousal
Optimal Performance
Impaired performance
because of high
anxiety
Increasing attention
and interest
Low
High
Anxiety

What is the cause of maths anxiety?



Pekrun (2006)

THE MATHEMATICAL ASSOCIATION OF VICTORIA

KEYNOTE PRESENTATION

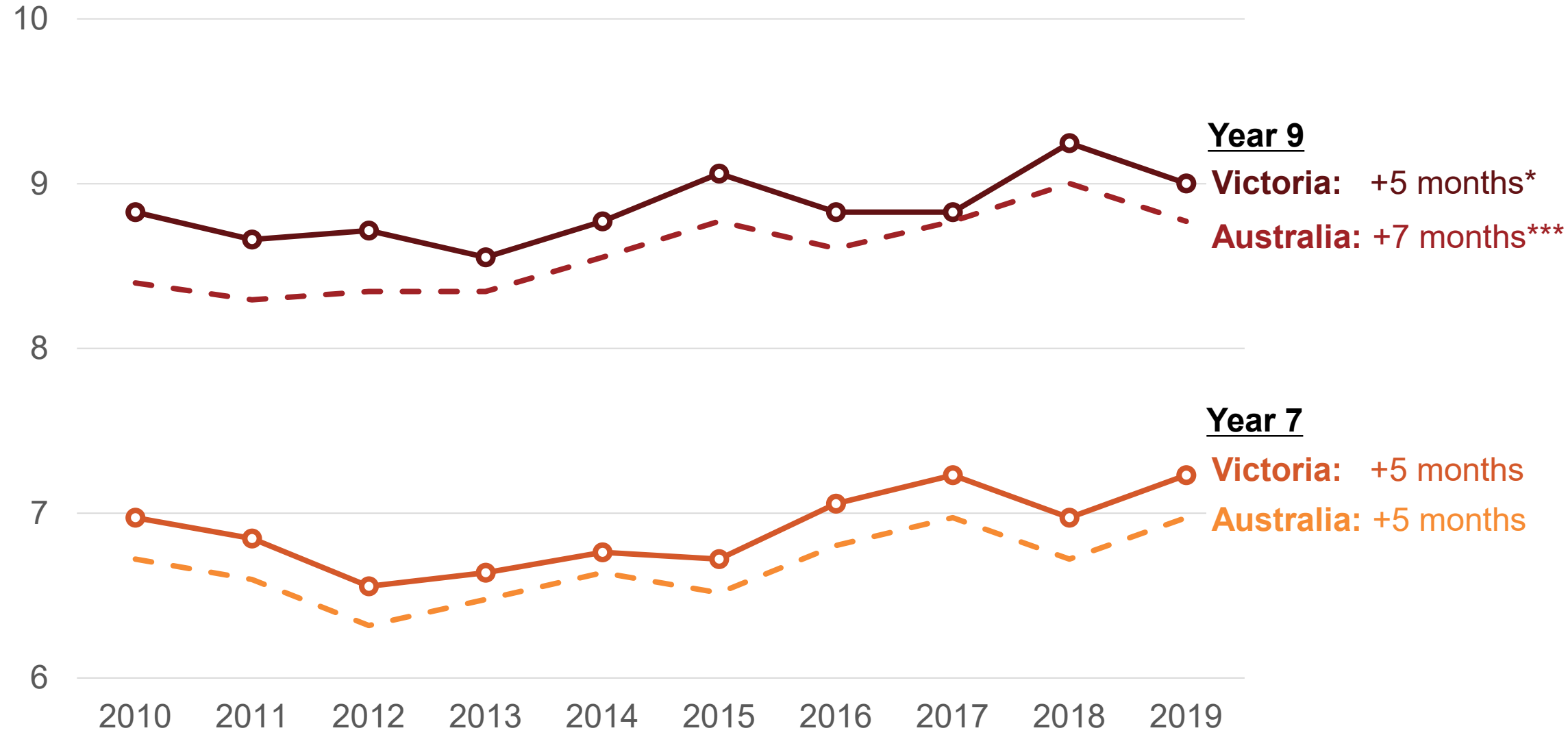
Peter Goss
School Education Program Director
GRATTAN Institute
peter.goss@grattan.edu.au

Panel Discussion

What's up with secondary school mathematics, and how can we improve it?

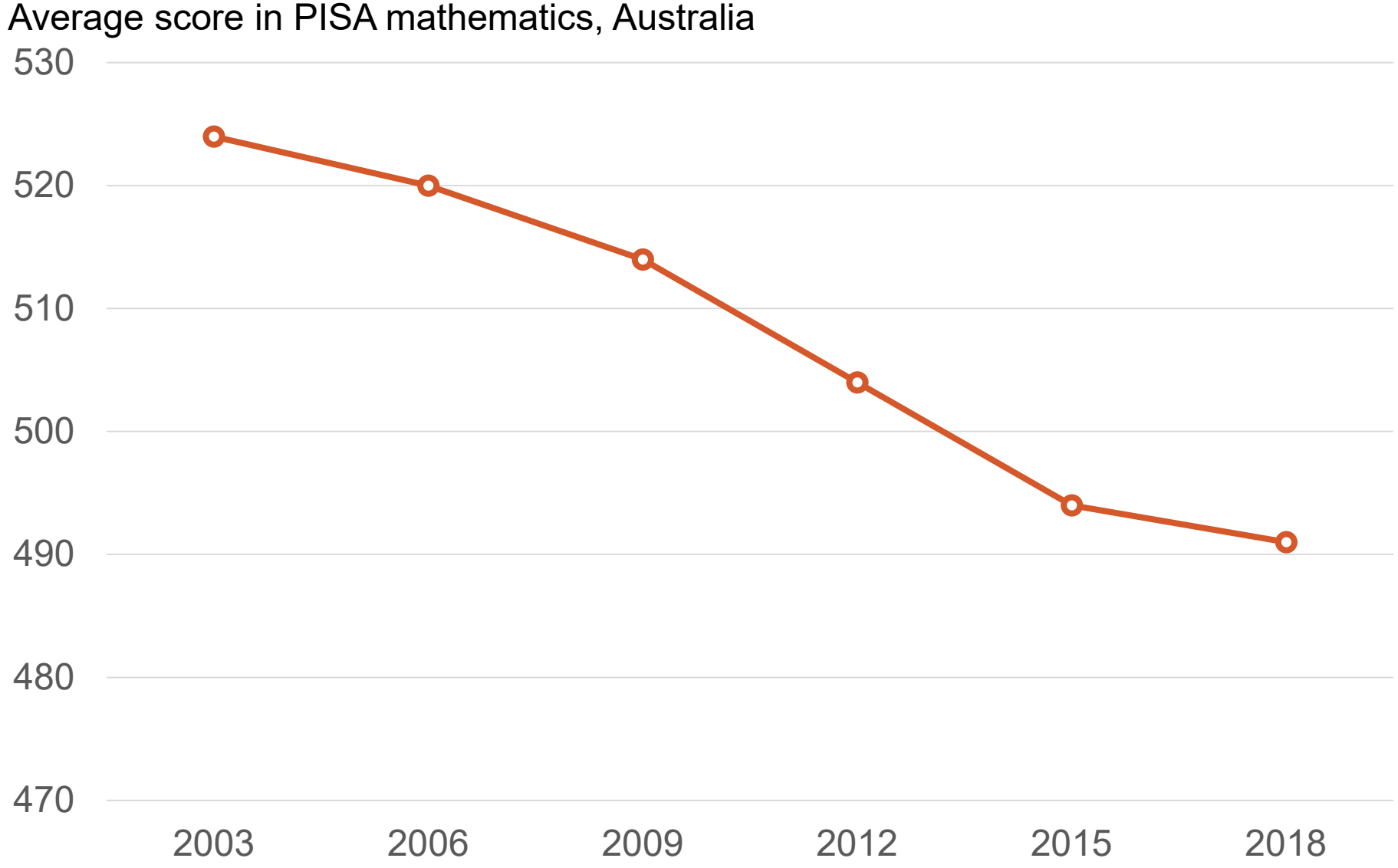
Where are we?

NAPLAN numeracy results are improving



Note: NAPLAN scores converted to Equivalent Year Level using the methodology described in Measuring student progress (Goss and Sonnemann, 2018)
Sources: ACARA, Grattan analysis

Australia's PISA results are not



Source: OECD

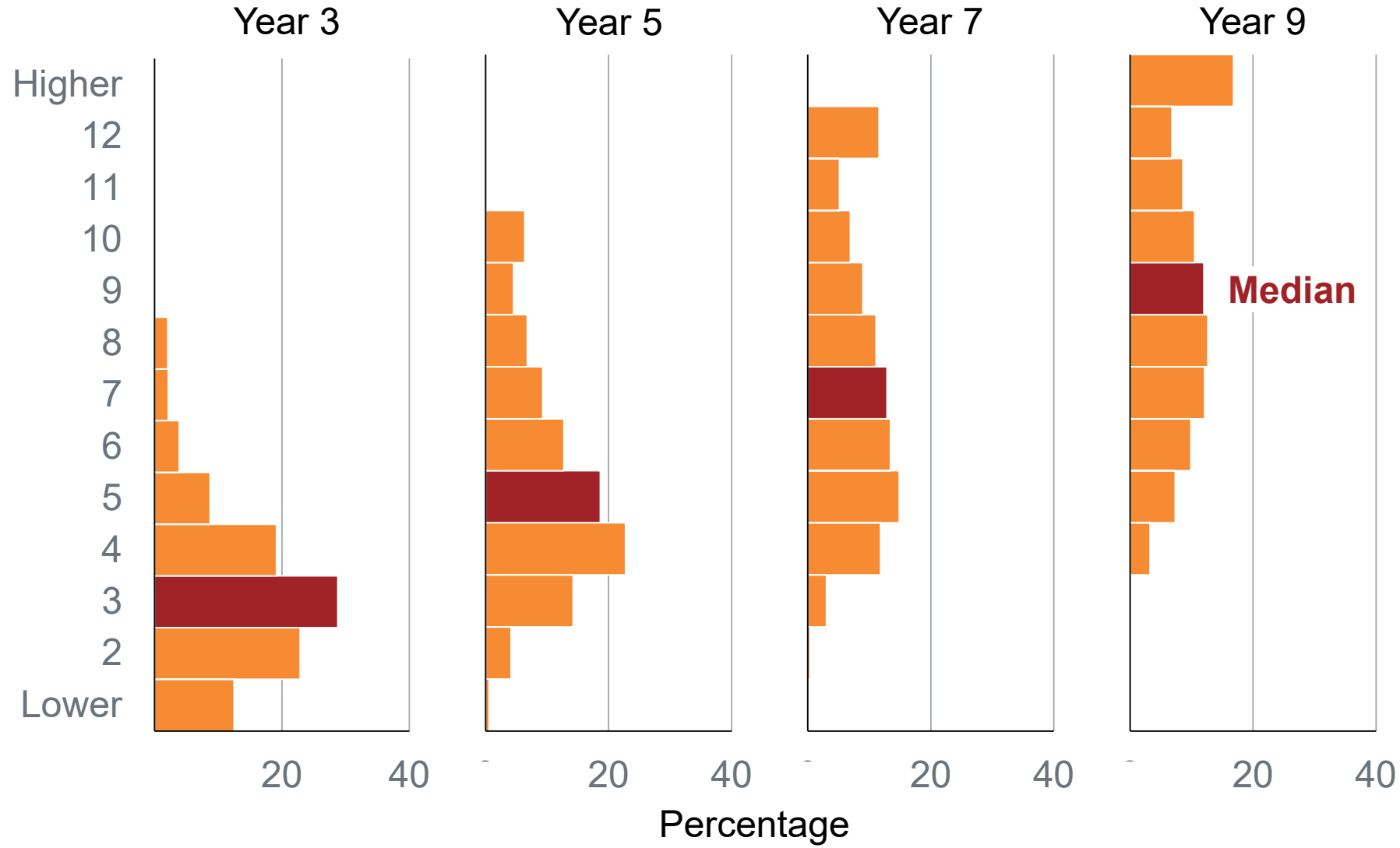
NAPLAN versus PISA

NAPLAN?

PISA?

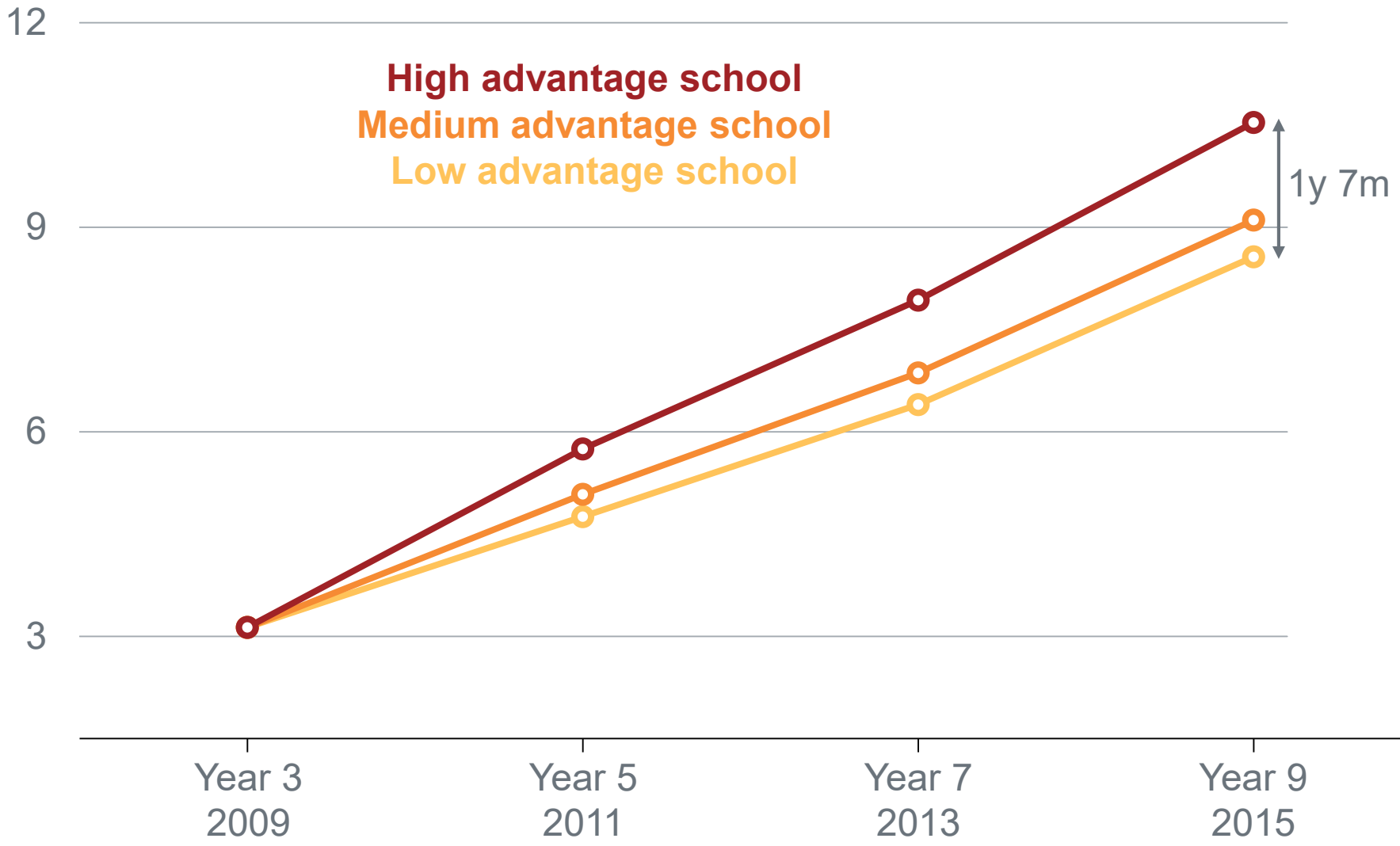
The spread in numeracy levels is huge

Equivalent year level grouping, numeracy, Australia, 2014



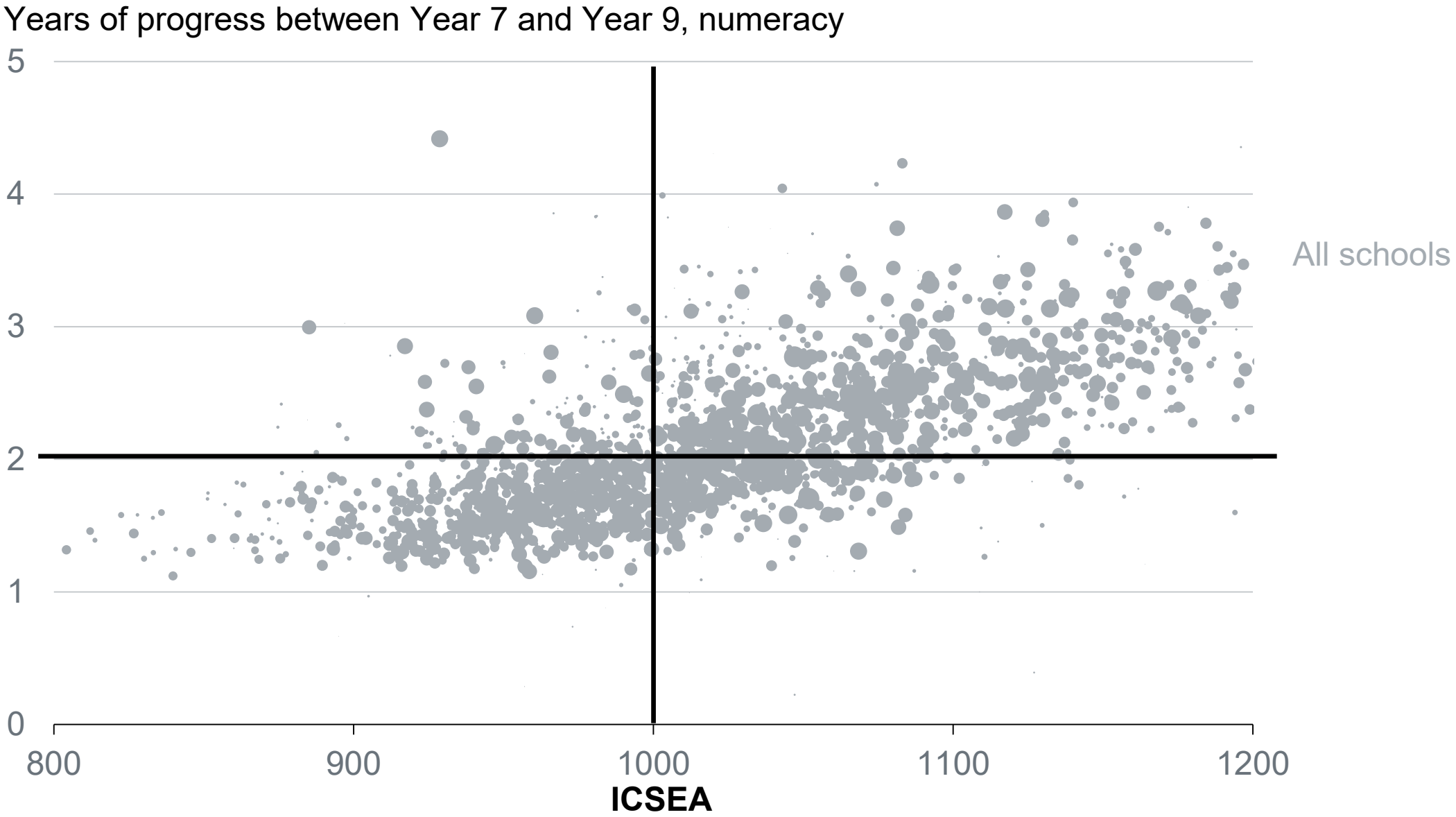
Note: Figure 6 of Widening Gaps (Goss and Sonnemann, 2016)
Sources: ACARA, Grattan analysis

School (dis)advantage affects progress



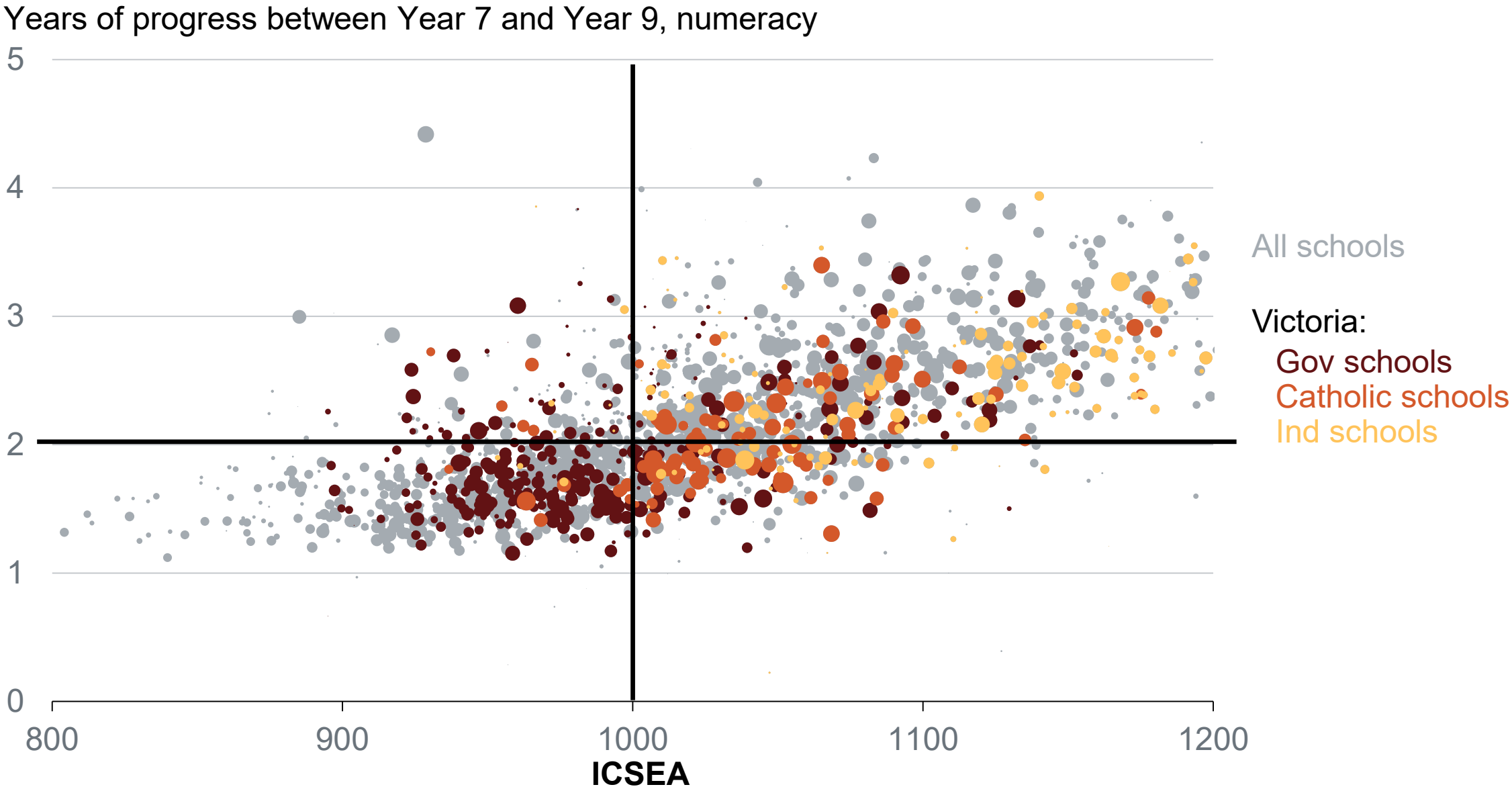
Note: Adapted from Figure 14 of Widening Gaps (Goss and Sonnemann, 2016). Students shown have median Year 3 scores.
Sources: VCAA, ACARA, Grattan analysis

Individual schools have very different impact



Notes: Size of dot represents number of students in Year 7-9 at school. Each dot represents the average of five cohorts of students from 2010-12 to 2014-16.
Sources: ACARA, Grattan analysis

Individual schools have very different impact



Notes: Size of dot represents number of students in Year 7-9 at school. Each dot represents the average of five cohorts of students from 2010-12 to 2014-16.
Sources: ACARA, Grattan analysis

Summary of where we are

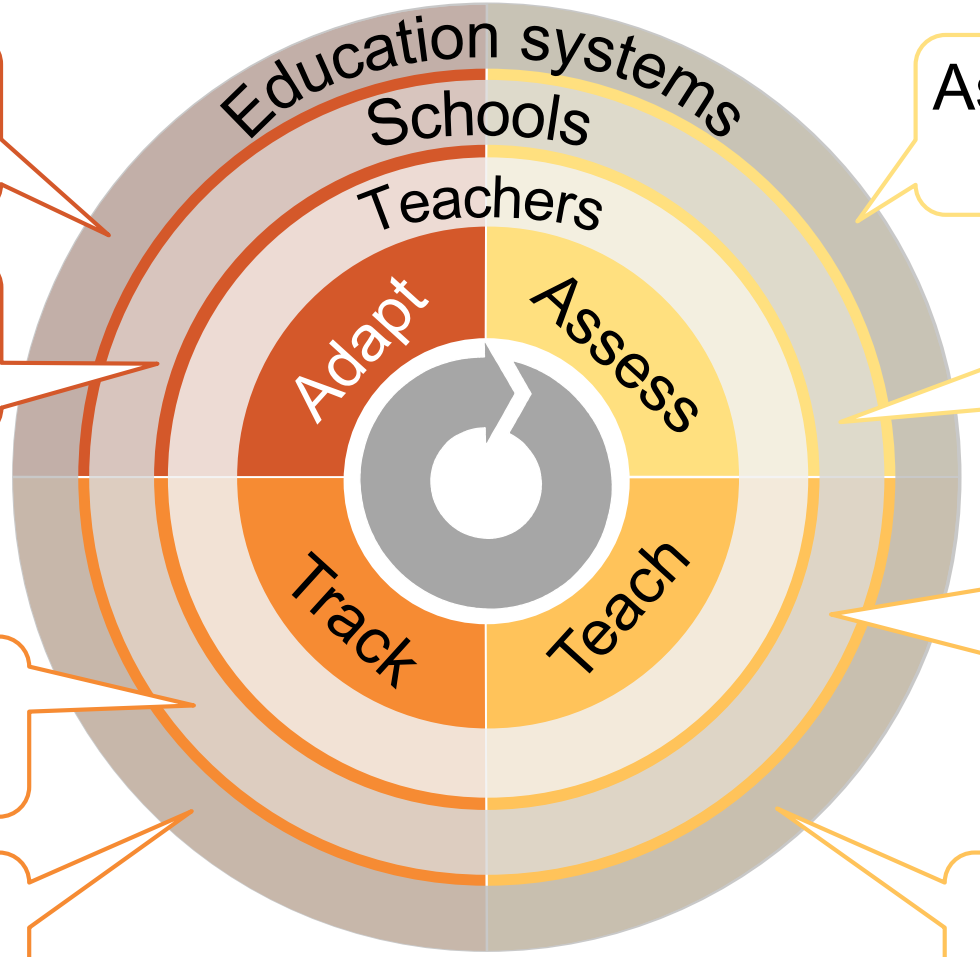
NAPLAN is improving, PISA is not

Ongoing challenges:
- The spread of learning
- Impact of disadvantage

Individual schools really matter

What to do?

Targeted teaching (~differentiation)



Systems to capture & spread best practice

Culture of continuous improvement

Ability to track student progress over time

Learning progressions linked to curriculum

Assessments linked to teaching resources

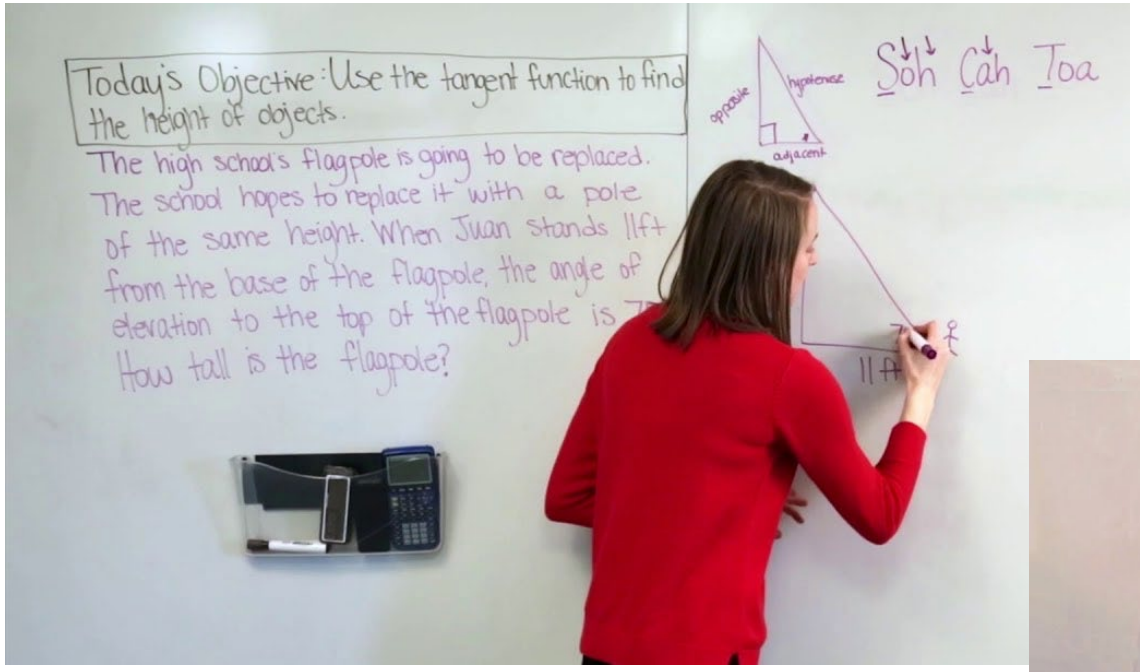
Common formative assessment tasks

Timetable enables regular discussions between teachers

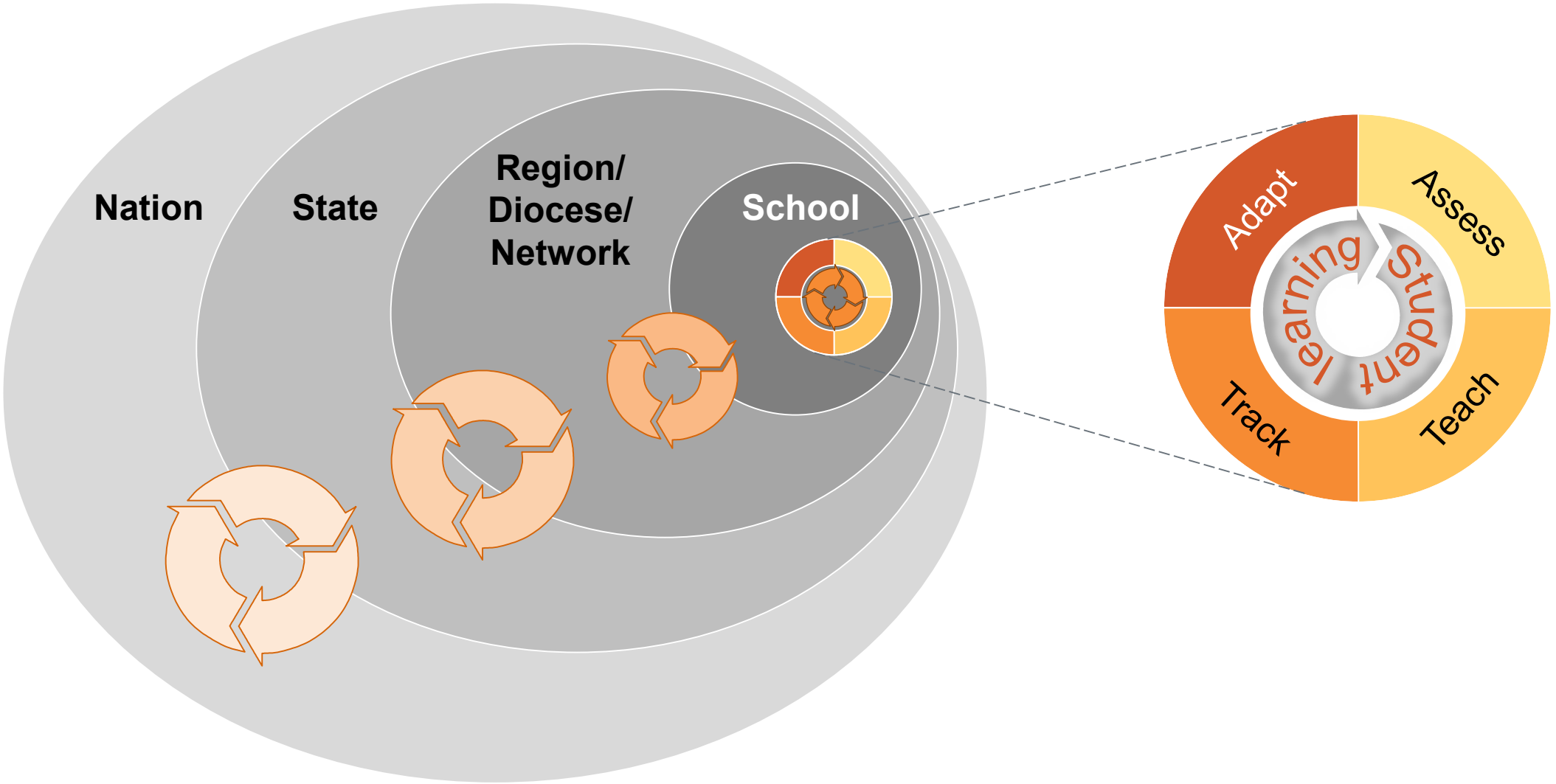
Expert support and instructional coaches

Source: Towards an Adaptive Education System, Goss (2017)

Explicit teaching and inquiry learning

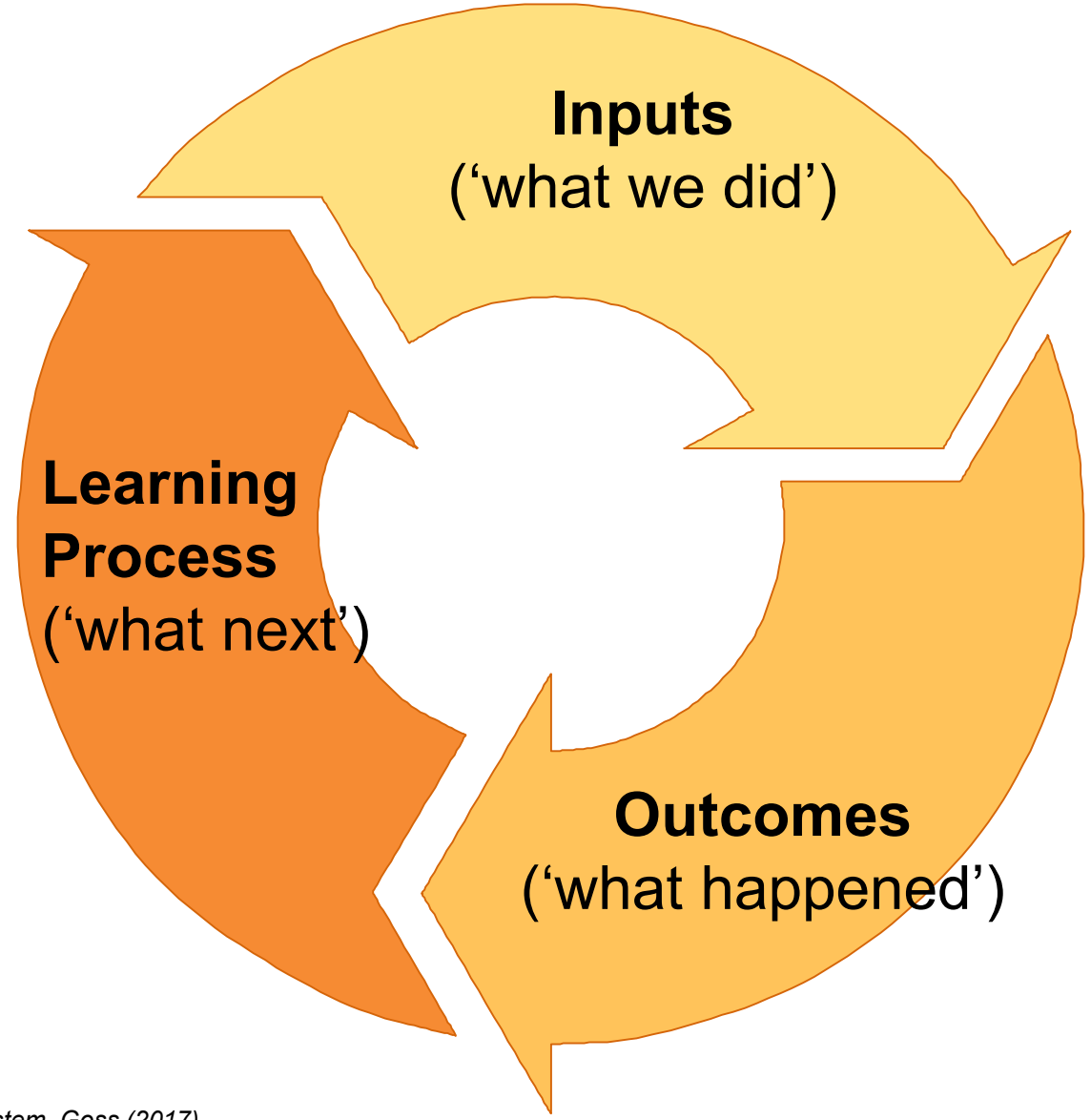


System learning at multiple levels



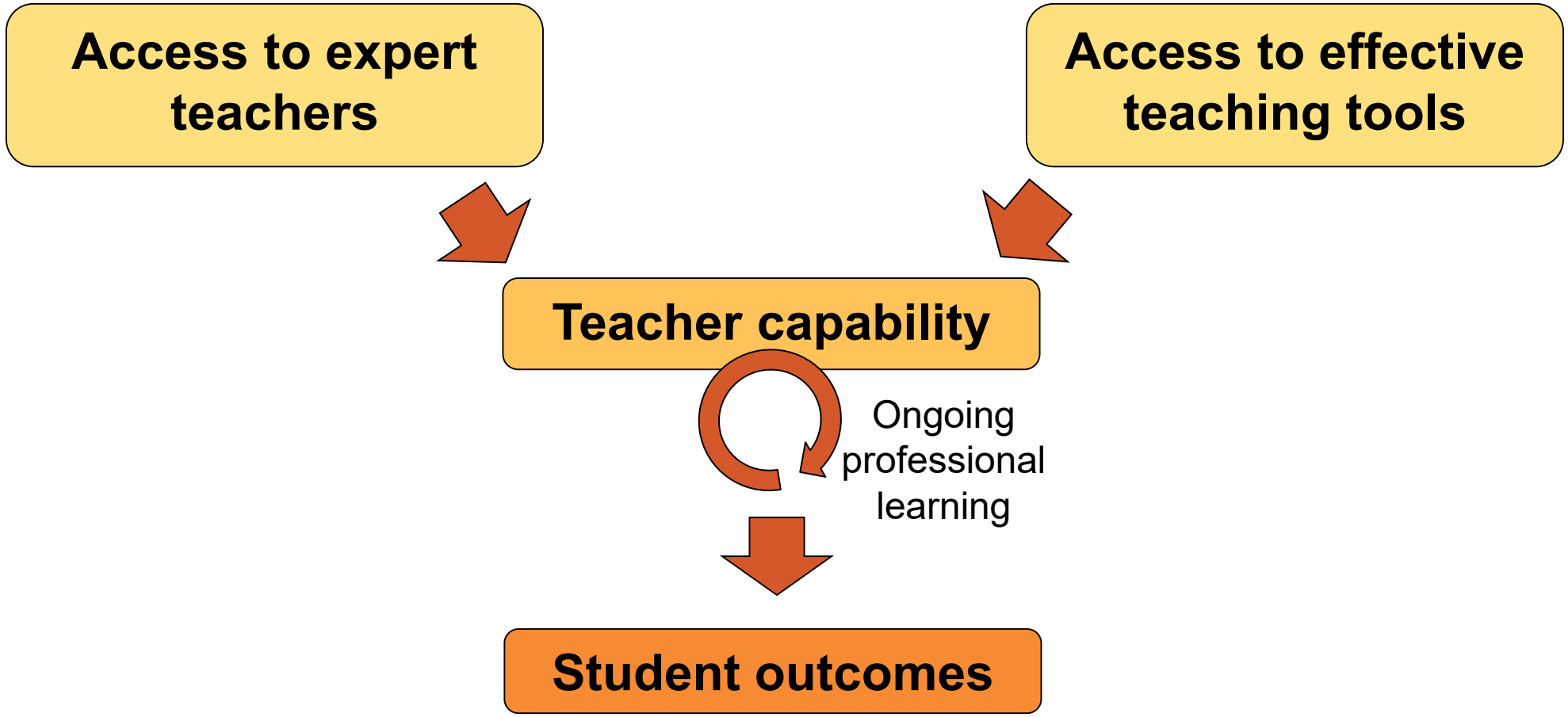
Source: Towards an Adaptive Education System, Goss (2017), inspired by The biology of corporate survival (BCG, 2016)

Adaptive improvement takes three steps



Source: Towards an Adaptive Education System, Goss (2017)

Better access to expertise and 'tools'



A/Prof. Sebastian Sardina RMIT University

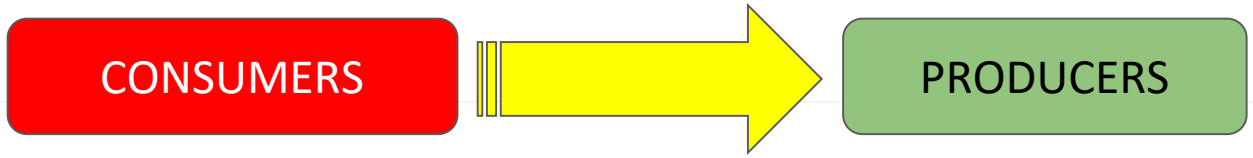
Towards Maths in Action: Mathematics meets Computational Thinking

Maths in Action: Mathematics meets Computer Science

"Algorithms" included in VIC F-10 since 2017 under **Math / Number and Algebra.** ***Why...?***

- ➔ Arithmetics allows us to **deal with abstract numbers** ("fourteen") in terms of **concrete symbols** (14, XIV, or 1110) that are **manipulated** according to **rules**.
- ➔ Computation allows us to **deal with abstract ideas** in terms of **concrete symbols** that are **manipulated** according to clear **rules** and **processes**.
  - ◆ Algorithms: just a convenient way to represent the rules and processes!

Why is Algorithmic Thinking important?

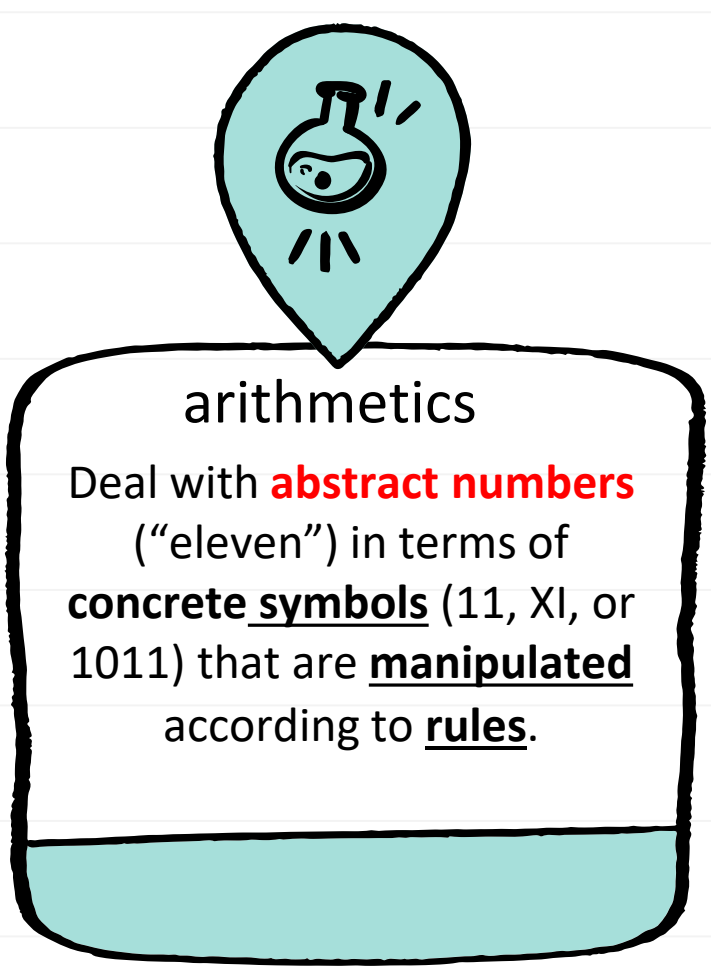


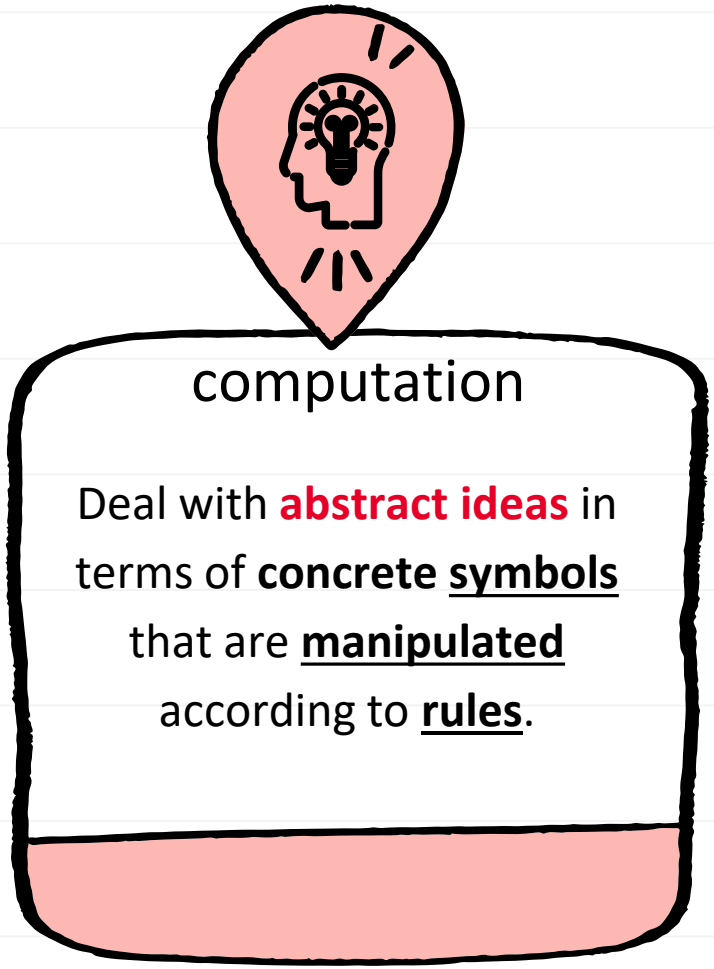
1. Will permeate **everything our students will do**, regardless of career.
   - *"Australians are not aware of, and not prepared for, the changes that are likely to come ... in the labour market"* — McKell Institute Nov'19
2. Will promote **healthy democracy:** need literate electorate and leaders.
   - It is not magic or for an elite: AI, surveillance, privacy, digital security & currency.

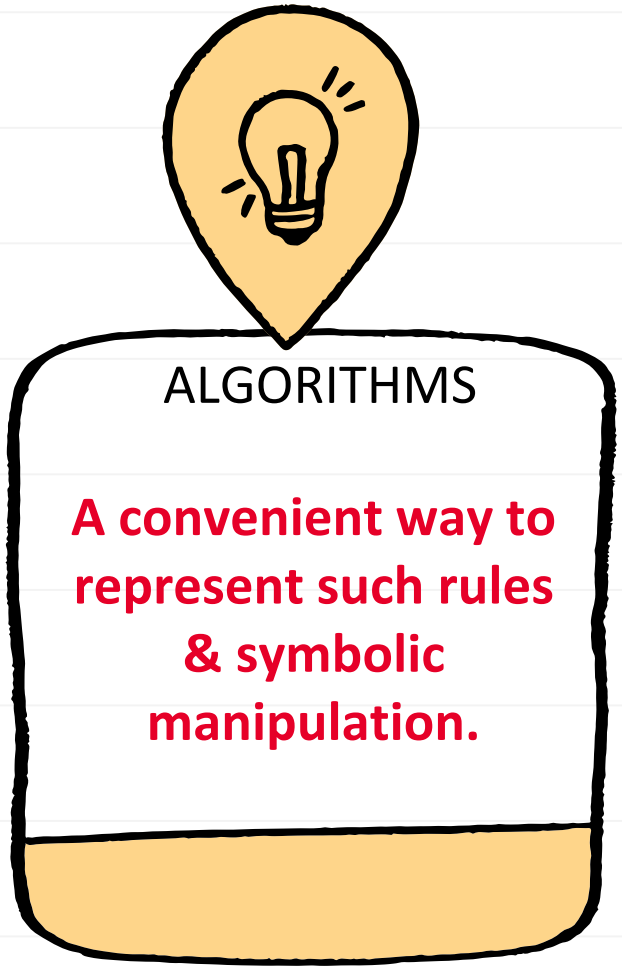
Math teachers and Computer Scientists can (and should!) work together to bring this about: ***Maths in Action!***

Why do Computer Science come to Mathematics?

- ➔ Since 2017, algorithms in VIC F-10 Mathematics curriculum in 2017.
- ➔ Under strand **Number and Algebra (Patterns and algebra).** ***Why us?*** **;-)**







Maths in Action: Mathematics meets Computer Science

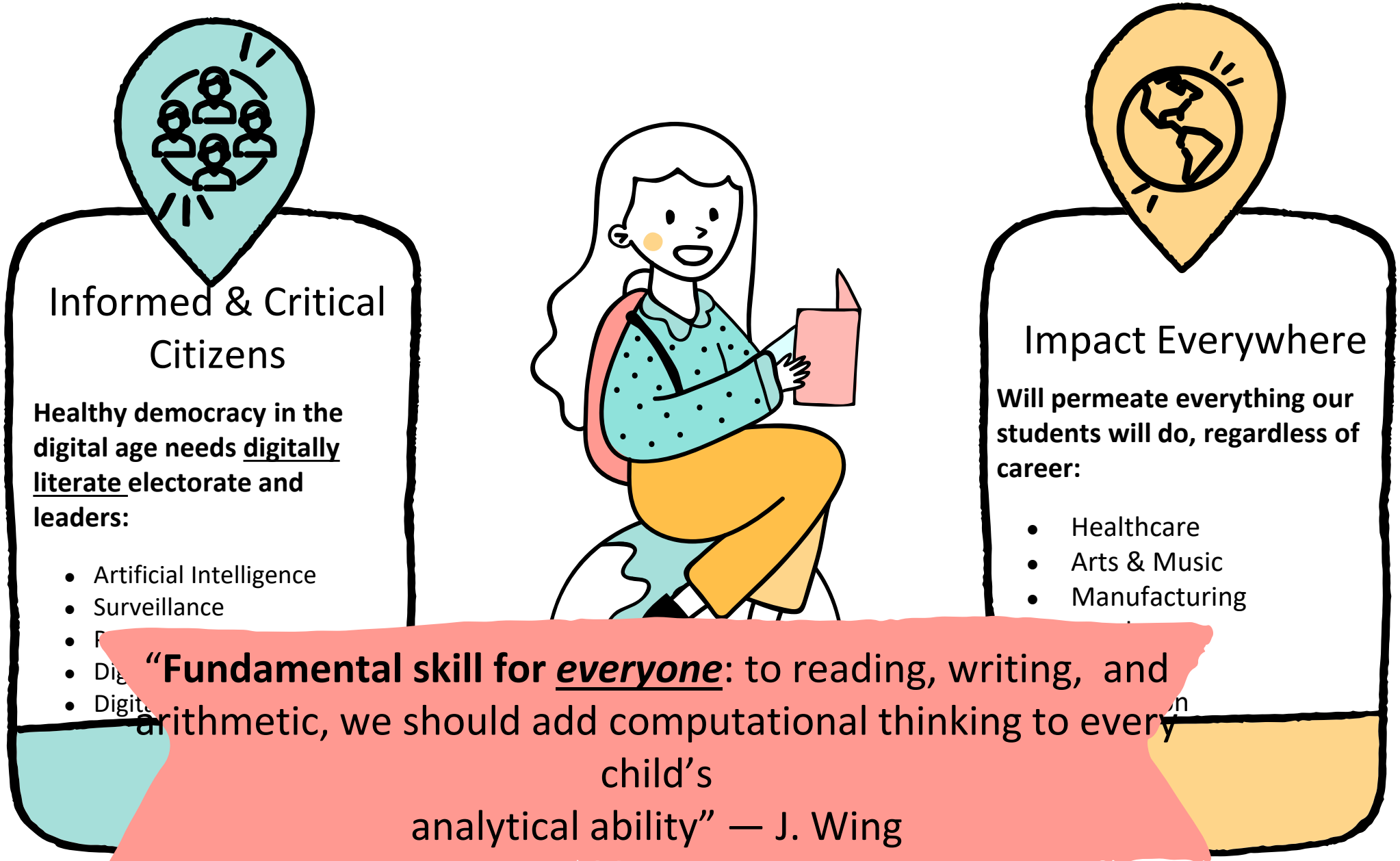
→ **Mathematic teaching can support Computer Science teaching:**

- Maths is the **foundation** of Computer Science (e.g., logic, set theory)!
- Lots of **math problems** CS can directly leverage on (gcd, fibonacci)

→ **Computer Science teaching can support Mathematic teaching:**

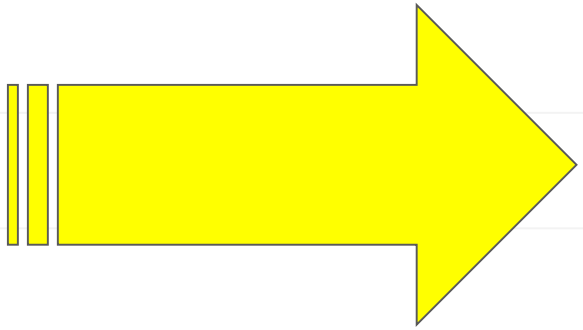
- CS can help put **maths in action**!
  - From abstract pencil-and-paper problems to concrete **programming** problems.
  - Math applied in the real world, using an **exciting, hands-on** approach to **create** something "cool" and concrete.
- Builds **essential attitudes**: confidence + tenacity + curiosity + engagment.

Algorithms are everywhere….



"**Fundamental skill for *everyone***: to reading, writing, and arithmetic, we should add computational thinking to every child's analytical ability" — J. Wing

move beyond the mere consumption of technology….



CONSUMER / USER

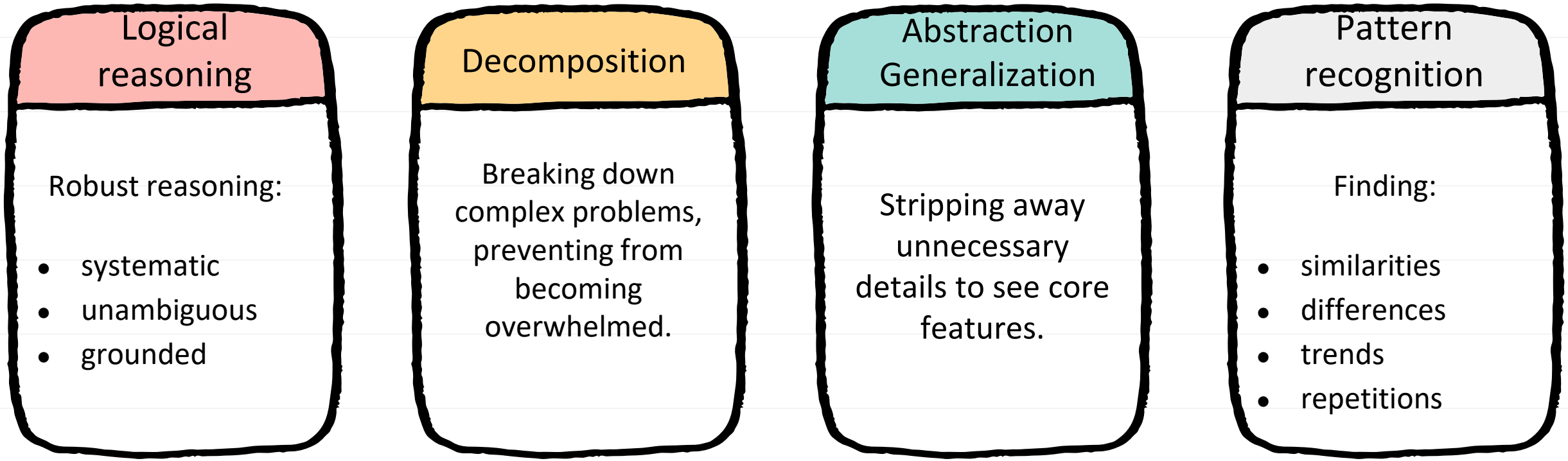
PRODUCER / CREATOR

“Australians are not aware of, and not prepared for, the changes that are likely to come … in the labour market”

McKell Institute Report - Nov’19

Joining Forces: Math in Action!

Algo. as a robust, clear, and precise framework to **develop general problem-solving skills**:



Essential Attitudes

Builds and support: *confidence*, *tenacity*, *communication* skills, *curiosity*, *intentional attitude*, *growth mindset*.

THE MATHEMATICAL ASSOCIATION OF VICTORIA

KEYNOTE PRESENTATION

Neil Carmona-Vickery
Director
Monash Tech School
neil@monashtechschool.vic.edu.au

Panel Discussion

What's up with secondary school mathematics, and how can we improve it?

THE MATHEMATICAL ASSOCIATION OF VICTORIA

Schools

Tertiary & Research

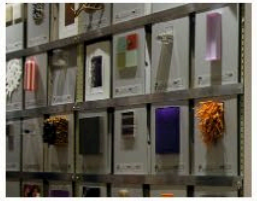
Government

Industry

Community

MONASH TECH SCHOOL

Design your future now



Materials Science

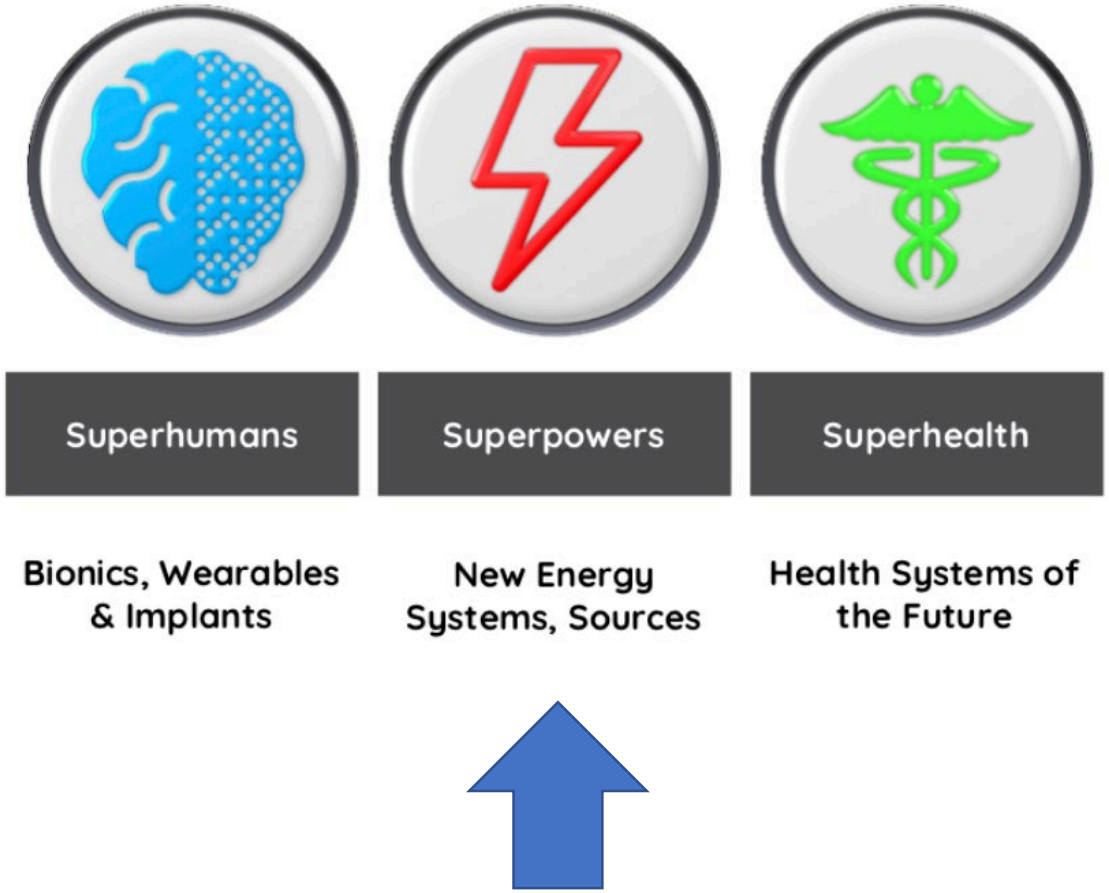
New Energy

Pharmaceutical Science

Medical Technologies

Entrepreneurship

THE MATHEMATICAL ASSOCIATION OF VICTORIA



How might we leverage the **Superpowers** program in a way that might help thousands of students understand how energy usage metering and billing works?

User

Monthly Costs

PEAK and OFF-PEAK STANDING RATE OFF PLAN

jan	87.48	jan	130.48
feb	77.07	feb	112.79
mar	81.14	mar	119.56
apr	96.37	apr	148.47
may	107.51	may	165.24
jun	105.69	jun	164.07
jul	114.64	jul	179.32
aug	115.38	aug	177.87
sep	99.36	sep	153.78
oct	87.93	oct	133.69
nov	88.81	nov	132.49
dec	89.97	dec	134.25
	1151.37		1752.04

User

Monthly Costs

PEAK and OFF-PEAK STANDING RATE OFF PLAN

jan	53.48	jan	79.14
feb	52.87	feb	76.64
mar	56.56	mar	81.21
apr	52.87	apr	76.52
may	63.17	may	93.57
jun	59.19	jun	89.41
jul	47.12	jul	66.57
aug	68.25	aug	103.95
sep	56.90	sep	83.66
oct	48.09	oct	68.29
nov	45.01	nov	61.91
dec	48.01	dec	67.26
	651.52		948.13

User

Monthly Costs

PEAK and OFF-PEAK STANDING RATE OFF PLAN

jan	141.52	jan	200.84
feb	138.44	feb	190.78
mar	128.60	mar	176.15
apr	86.19	apr	116.10
may	81.27	may	108.90
jun	70.62	jun	93.98
jul	78.06	jul	104.34
aug	91.16	aug	122.95
sep	113.10	sep	154.35
oct	126.45	oct	173.10
nov	134.61	nov	185.03
dec	135.67	dec	186.21
	1325.71		1812.74

User

Monthly Costs

PEAK and OFF-PEAK STANDING RATE OFF PLAN

jan	78.18	jan	113.65
feb	72.22	feb	102.72
mar	80.15	mar	114.08
apr	80.32	apr	116.24
may	86.69	may	126.49
jun	85.49	jun	122.10
jul	87.68	jul	128.07
aug	89.15	aug	129.37
sep	79.48	sep	116.11
oct	45.04	oct	62.47
nov	71.38	nov	102.23
dec	74.04	dec	106.61
	929.82		1340.14

User

Monthly Costs

PEAK and OFF-PEAK STANDING RATE OFF PLAN

jan	42.17	jan	60.65
feb	39.35	feb	55.93
mar	66.92	mar	90.43
apr	54.48	apr	71.04
may	49.82	may	64.20
jun	43.65	jun	55.64
jul	51.27	jul	66.26
aug	55.52	aug	72.31
sep	43.18	sep	54.98
oct	51.22	oct	66.19
nov	50.08	nov	64.79
dec	88.23	dec	118.80
	635.88		841.23

User

Monthly Costs

PEAK and OFF-PEAK STANDING RATE OFF PLAN

jan	85.12	jan	134.03
feb	73.38	feb	110.57
mar	80.53	mar	123.35
apr	82.75	apr	120.77
may	170.77	may	269.35
jun	191.21	jun	309.29
jul	202.81	jul	324.66
aug	147.79	aug	230.76
sep	106.29	sep	154.28
oct	75.07	oct	113.00
nov	90.55	nov	134.58
dec	82.20	dec	124.46
	1388.46		2149.10

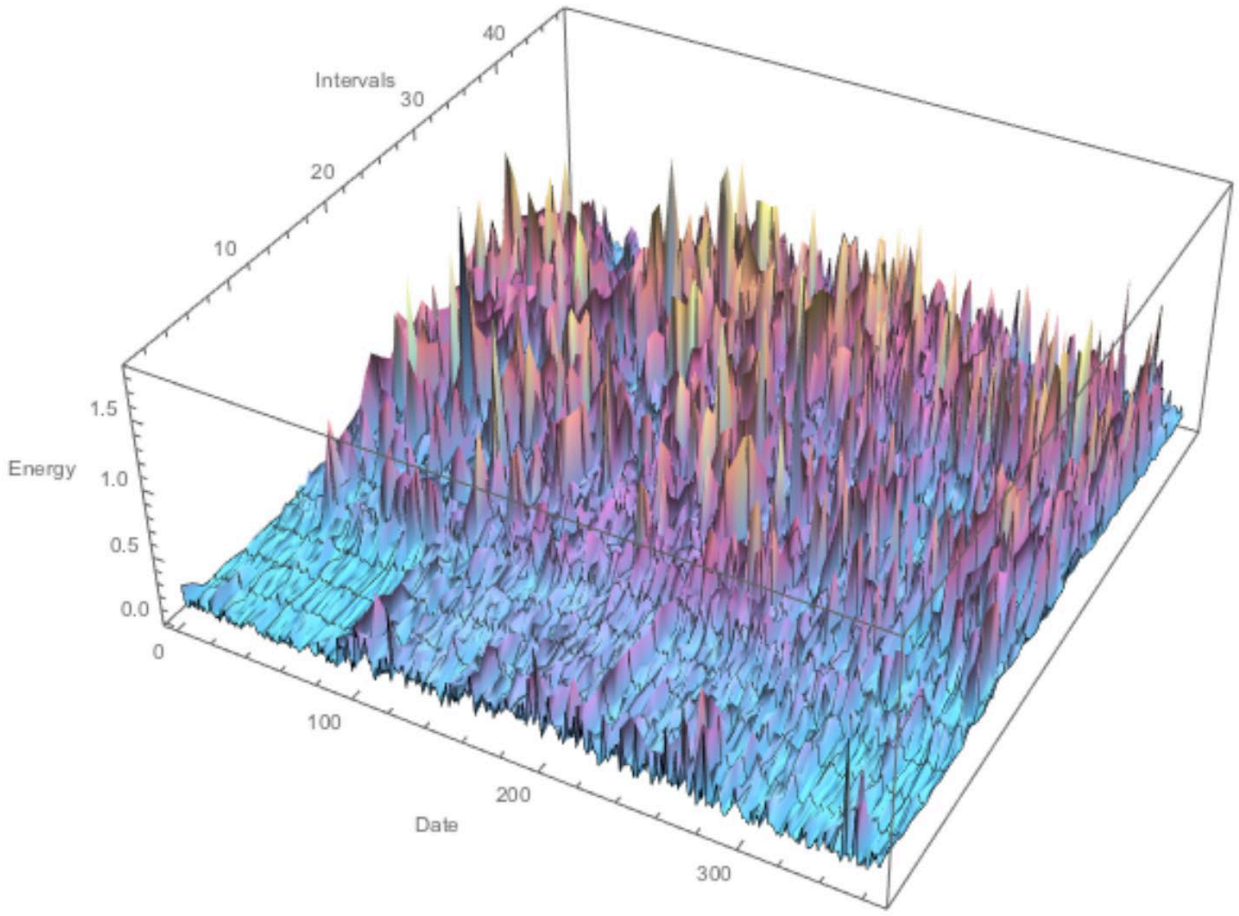
THE MATHEMATICAL ASSOCIATION OF VICTORIA

We **created**:

- 6 household profiles
- Each different

We **contributed**:

- Sourced data from family and friends



THE MATHEMATICAL ASSOCIATION OF VICTORIA

Mathematica :

- Ingested large dataset *
- Presented it in a visual manner *

Students:

- Appreciate the richness
- Generated talking points

* Solution developed with Gary Bass

MONASH
TECH
SCHOOL
Design your future now

Energy User Experiences

	Profile	Usage	Bills	Think | Feel | Do
 Apartment	Two people ... Income ... Bedrooms ... Bathroom ... Living rooms ...	What trends can you identify about energy usage over the year?	This household is not on an energy plan (Standing Rate Off-Plan). Their usage includes: 2636 kWh on peak and 3173 kWh off-peak a year. How much would they save per year if they took the time to call and subscribe to a plan?	Apartment dwellers aren't allowed to install their own solar panels on the roof. What could they do to access renewable energy?
 Unit	One person ... Income ... Bedrooms ... Bathrooms ... Living rooms ... Pet ...	During which month of the year is energy usage the lowest? Why do you think that is?	This busy professional often forgets to pay their bill on time. Comparing Power Rates between companies, would they be better off changing to a no fills energy plan or staying on the plan with a pay-on-time discount?	Lighting consumes between 8% and 15% of the average energy bill. Download the Light Bulb Saver App from the App Store or Google Play and identify which light bulbs are the most energy efficient.
		Energy use is high when ...	These home owners are considering installing a swimming pool to use over the summer. An electric pump will add 50 cents to the electricity bill per hour and a chlorinator will add 10 cents an hour to run. How much will it cost to run the pool	By installing LEDs this household could save ...

THE MATHEMATICAL ASSOCIATION OF VICTORIA

Teachers to students:

- What is happening?
- What might happen?
- What might be done differently?
- What can households do?
- What do you think?

THE MATHEMATICAL ASSOCIATION OF VICTORIA

Our Programs:

- Real-world problems & solutions
- Help students empathise with their parents and others
- Impact on the community economically

THE MATHEMATICAL ASSOCIATION OF VICTORIA

Learn more at
www.mav.vic.edu.au

COMMUNICATION
- Website and publications
- Matrix newsletter
- Advocacy
- News page
- Public events

CONFERENCES
- Annual conference
- Primary conference

PUBLICATIONS
- Prime Number (Primary journal)
- Vinculum (Secondary journal)
- Common Denominator (Magazine)

RESOURCES
- MAVshop
- Teaching resources
- Professional resources
- VCE trial exams, SACs, VCE solutions

PROFESSIONAL LEARNING
- Contracted in-school
- Network days
- VCE
- Professional learning events
- Virtual learning sessions

STUDENT ACTIVITIES
- Maths Talent Quest
- STEM events
- Maths camp
- Games days
- Family maths activities
- VCE revision lectures
- Made by Maths app

MEMBERSHIP
- Become a member
- Mathematics Active Schools