Growing Your Mathematical Mindset…
(and that of your Students'!)

AMSI AUSTRALIAN MATHEMATICAL SCIENCES INSTITUTE

QMAT

Early Years and Middle Years Conference

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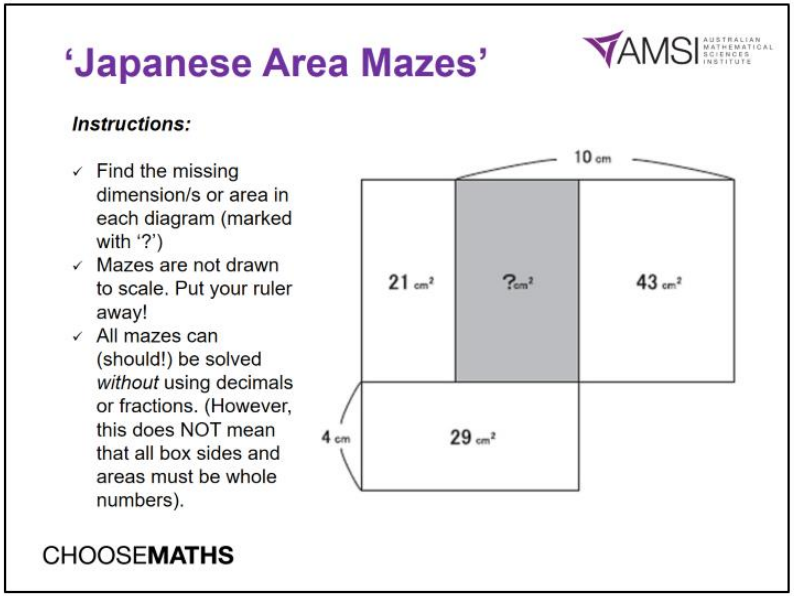
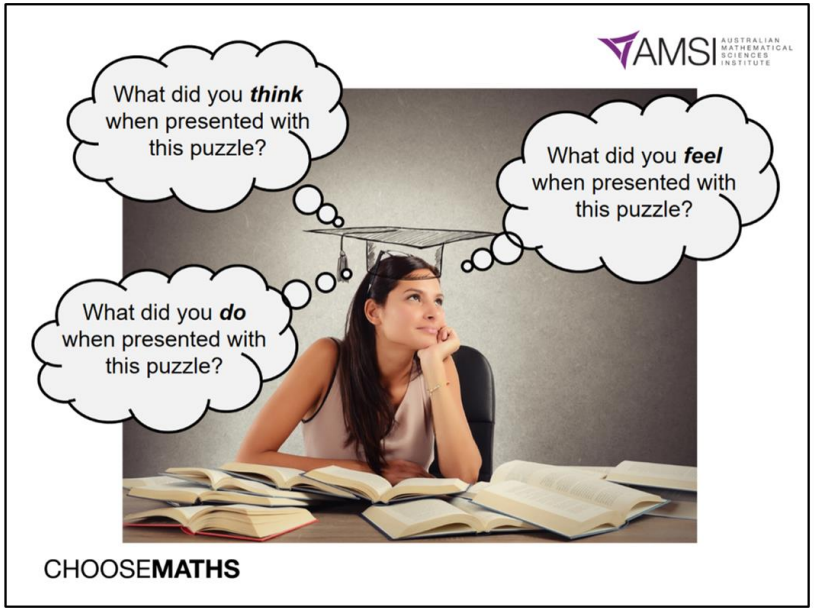
CHOOSE**MATHS**

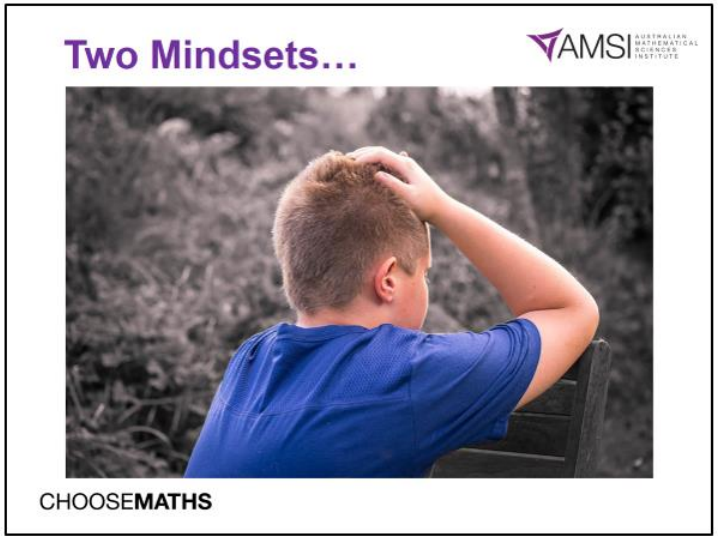
In this session:

1. Two Mindsets
2. My Brain is a Muscle
3. Hard Maths and 'The Zone'
4. The Importance of Mistakes - and Praise
5. The Role of a Teacher



To start, let's try a puzzle.

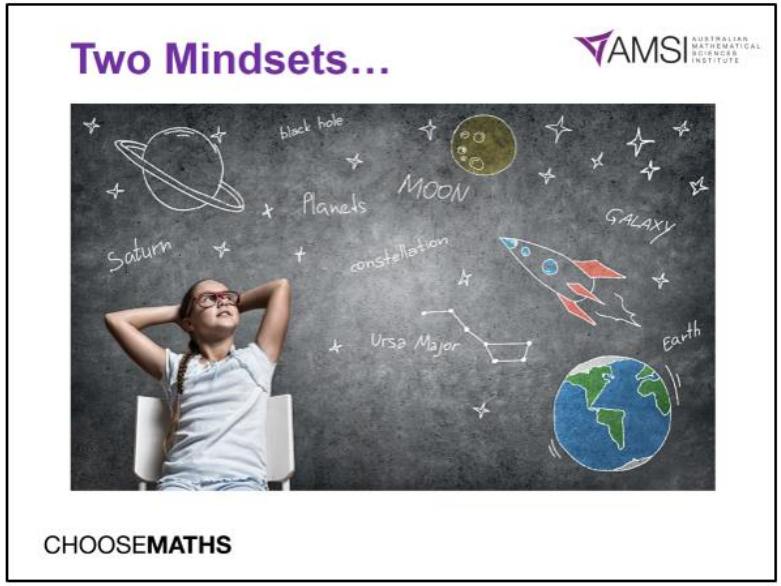




Dr. Carol Dweck - well known professor of psychology at Stanford University. She and her colleagues have argued that there are fundamentally two types of 'mindset' (a mindset being a set of beliefs about one's abilities that is persistent and pervasive):

A *fixed* mindset is one where we believe that our core personality, character, talent, abilities and intelligence are fixed. We are either smart, or dumb. We are either talented at something (art, music, sports, math, logic, etc.) or we aren't. In the fixed mindset world, we have no problems issuing statements like – "*He couldn't dance if he tried — he's got two left feet*" or "*She's got a green thumb – anything she touches, blooms*" or "*I just can't do maths, it just isn't my thing…*" and so on.

This self-belief is based on the notion that the human brain – and its latent abilities – is static, and doesn't – or at least rarely – changes.



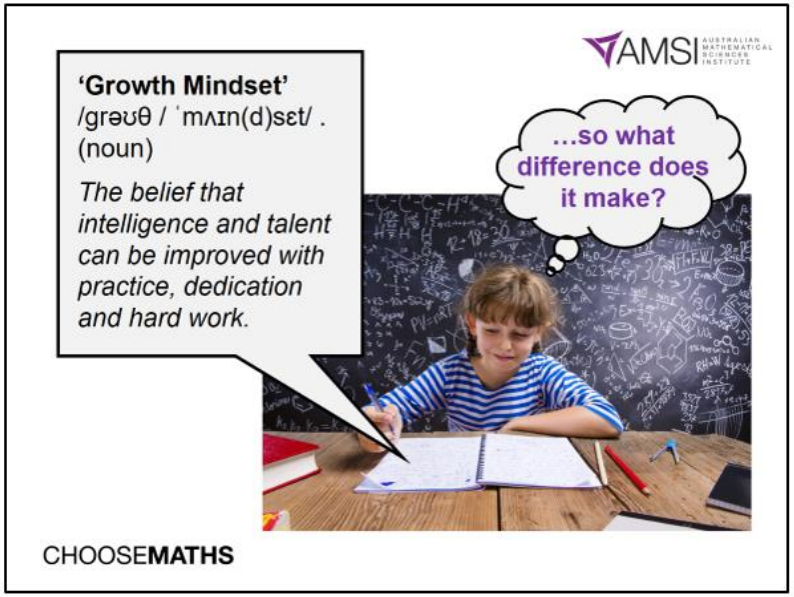
A *growth* mindset on the other hand, is the opposite, where we believe that the learning capacity – and therefore the abilities and aptitudes of an individual - are malleable. Through resilience, effort and application to learning, anyone can build themselves into something they want to be.

With a growth mindset, good, old fashioned – and utterly learnable - character traits like 'resilience', 'perseverance' and 'effort' replace static, unshifting personal beliefs like 'I'm stupid', 'I don't have the ability', 'I'm a genius' or my favorite: 'I'm awesome'.

A growth mindset in a person is rooted in the belief that despite difficulties or seemingly 'inbuilt' barriers, the brain can – and will – change over time, through new learning.

This activity provides a small illustration of the simplicity – but power – of taking a growth mindset.

We may think we are doing our best - but we often have more to give.

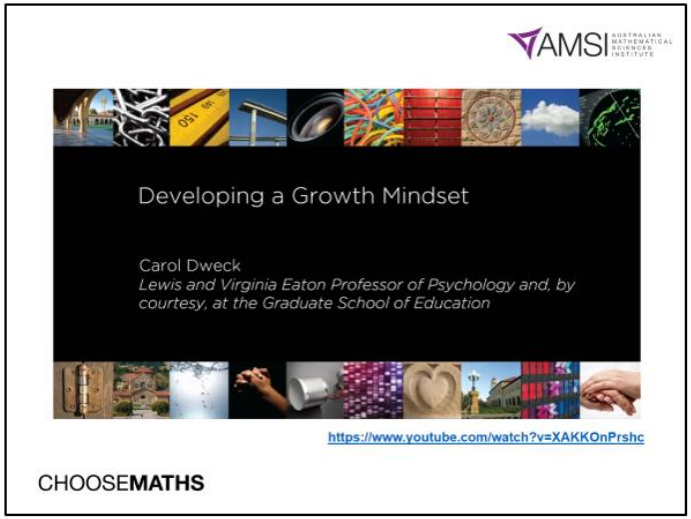


So, to emphasise, a 'growth mindset' is a set of beliefs in an individual that their intelligence, abilities, skills, aptitudes – and even attitudes – can be changed and improved for the better, through practice, dedication and hard work.

Notice this is much more than simple 'self belief' or 'the power of positive thinking'. By all means it starts with positive thinking – the belief that your brain can and will change – but it also requires hard work and application. I like to call Growth Mindset as "The Secret" for thinking people.

What difference does this make? Plenty. It thoroughly impacts on the way students, children – and adults – tackle difficulties and challenges, and thus directly impacts on their chances of long term success.

Here's what Dr Dweck has to say about growth mindset and the difference made by what she calls 'The Power of Yet'...



This video explains using an example between fixed and growth mindset. It focuses on students' responses to *failure* – their response to the processing of errors and stress, and the impacts on the human brain.

Note that Dr Dweck insists that the growth mindset response is intellectual, rather than emotional.

Think about this might change our students' responses to difficulties and errors in mathematics:

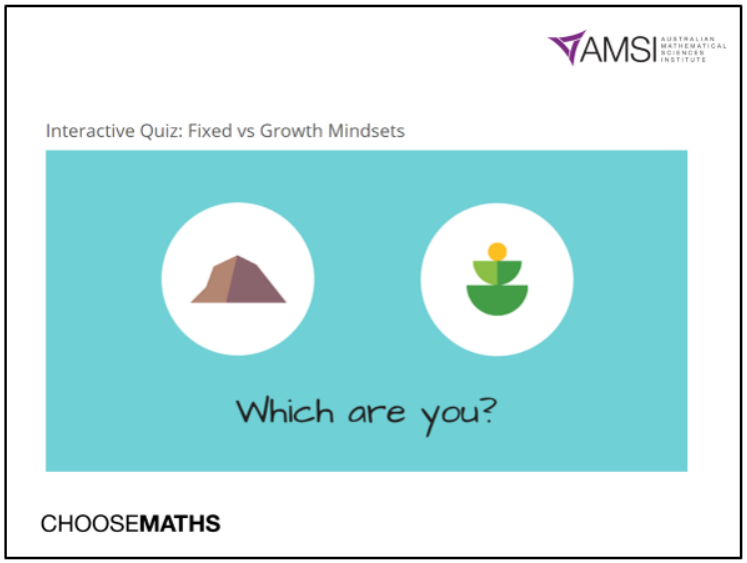
"I don't understand Fractions... Yet."

"I can't subtract... Yet."

"My students can't do worded questions... Yet."

"I can't solve this Japanese Area Maze puzzle... Yet."

Discuss how adding 'yet' to each of these sentences gives students and teachers a path for the future. Students choosing this mindset look for a window into the future' rather than shutting down the potential for further growth. They refuse to be stuck in the 'tyranny of "now"'.

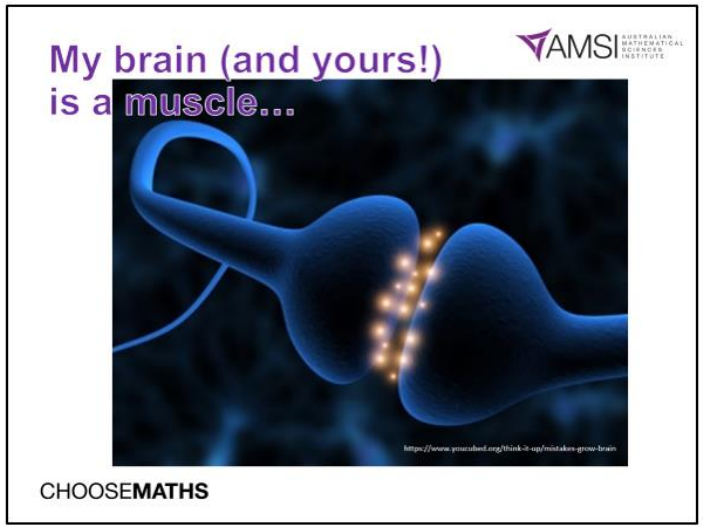


To try later on: 'Test my Mindset': http://www.londonacademyofit.co.uk/learning-blog/learning/interactive-quiz-fixed-vs-growth-mindset/

There are other materials and videos on this site (eg. "Your brain in plastic"). It's worthwhile checking it out.

However, one of the key messages here is that it's difficult pushing a 'growth mindset' onto our students if we don't have one ourselves.

What do we *truly* believe about our own capacity to learn?



Here's where some of the science comes in.

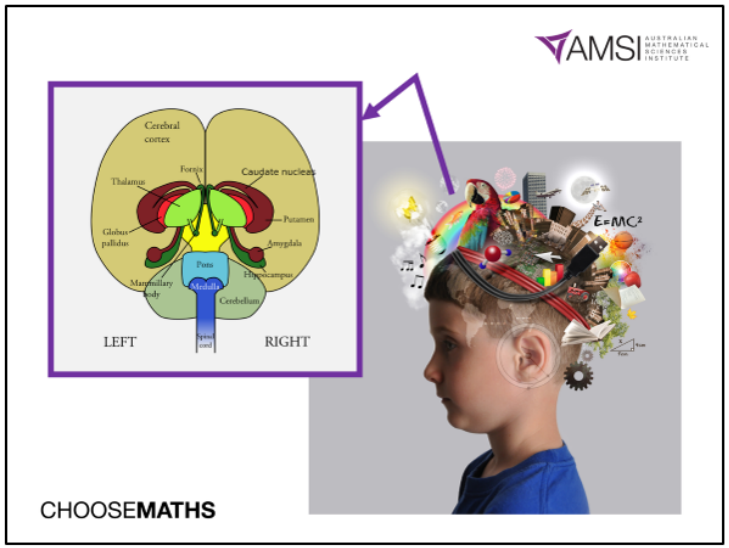
Brains are made up of millions of cells that make connections (called synapses). In order to learn something new, we need to make these connections, fire them up and continue to keep them firing. It's like the HDMI or aerial cable to your TV. If there is a break in it the cable, the TV won't work because the electrical and digital messages don't get through to the television, to process into sound and picture.

Numerous studies have shown that struggling with a problem, trying new methods, thinking about it, discussing it and persevering actually cause brain development (increased firing of synapses and connections between neurons).

When you think about something, struggle with it, talk about it and finally learn it, your brain cells make *new connections* – and literally grow in their capacity to process information. It's just like a muscle – it increases its capacity through exercise and work!

This increased brain development allows greater understanding and more chance of skill mastery.

What is even more astounding is that when children are taught this, their results improve.



We get 10 000 pieces of information per second. The amygdala is the brain's 'filter' – it receives all this information and it controls the way we react to certain of that *stimuli*. Without consciously thinking, the amygdala causes an emotion when we are in a situation that we see as potentially threatening or dangerous. No thinking takes place here; we just react *emotionally*. If a snake lands in your lap you don't want to waste time thinking, you just need to react. However, the thing is we do not think rationally with this part of the brain.

It's the thalamus that helps us sort the information – such as, by deciding whether it's useful or relevant to us. It serves as a kind of "gate," filtering which information from various channels is allowed to be relayed by it for processing in the cortex. To do this, the thalamus may override the emotional reaction we have to a situation, once we realise a threat is either not real or can be overcome. Finding a harmless huntsman spider on your bedroom wall when you turn on the light is a good example.

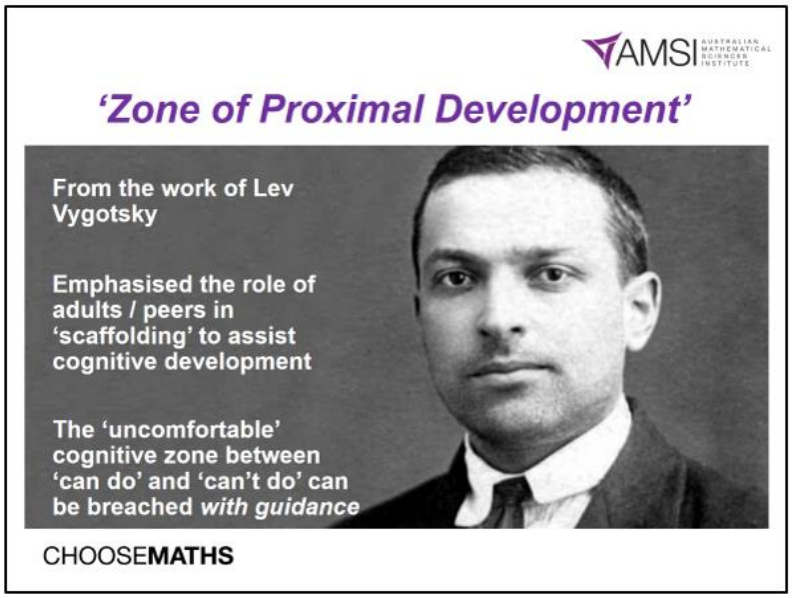
It's only then when the thalamus sends information through to the cortex that the new neurons in the brain are activated – and we grow our brain.

Something we consider difficult may be treated this way. We need to get this to our prefrontal cortex so we can do some thinking. Often takes some training!

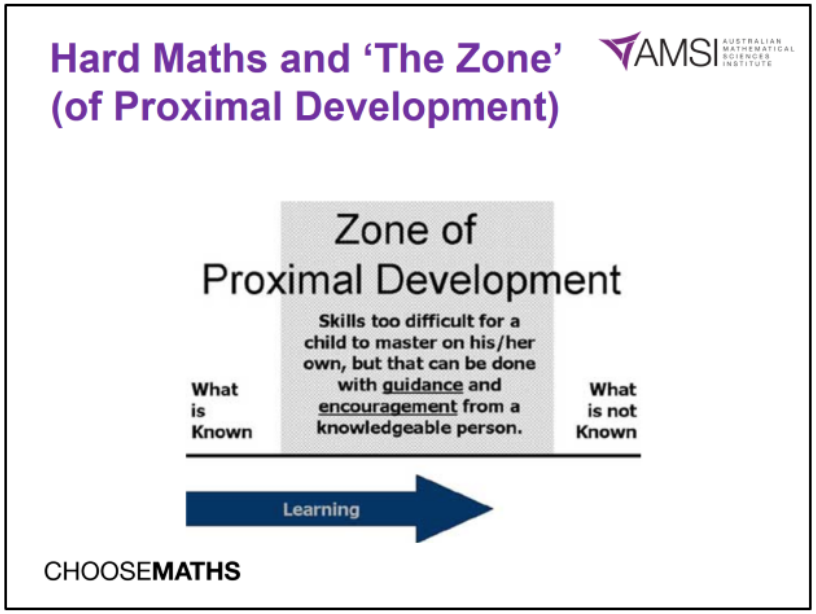
What do the 'fight, freeze or flee' reactions look like in the *classroom*? What emotional responses to new challenges do we often see from students?

Something as simple as adding the word 'Yet' – for example, "I can't do this …. YET" - is enough to keep the brain from simply reacting, to sorting, processing – and thinking.

However, the brain does not get to 'exercise' unless we actively think about our thinking – called 'metacognition' – and decide to push into a challenge or problem. This increased brain development allows greater understanding and more chance of skill mastery.



'Zone of Proximal Development' – Lev Vygotsky
https://www.simplypsychology.org/Zone-of-Proximal-Development.html
https://www.simplypsychology.org/vygotsky.html



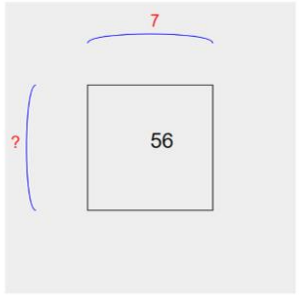
Lev Zygotski's 'Zone of Proximal Development'

This is the zone of thinking (and feeling) that lies between tackling tasks that we're wholly comfortable with – the 'What is Known' – and the zone of thinking in which we're completely lost and incapable of completing on our own.

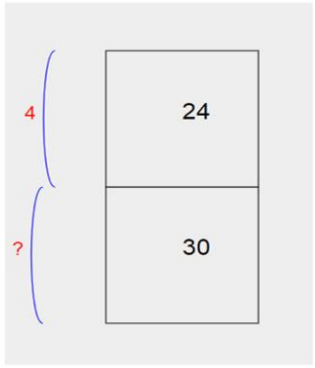
What lies between is a stage of learning – during which new neuronal connections are being built – in which we require some assistance or 'scaffolding' to help us complete unfamiliar tasks.

Gradually that scaffolding is removed until we are able to handle the problems ourselves. However, in the mean time, being in this zone is uncomfortable – we may *feel* challenged, frustrated, anxious. However, it is in this very 'zone' that our brains are creating new synaptic connections – and growing their capacity. We are *learning*.

"I can't do Area Maze Puzzles… Yet."



What did you think about?
What did you do?



What did you think about?
What did you do?

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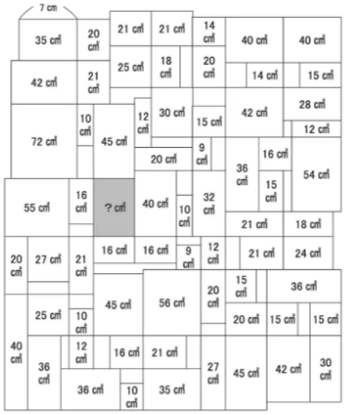
"I can't do Area Maze Puzzles… Yet."

What would you need to think about?

What would you need to do?



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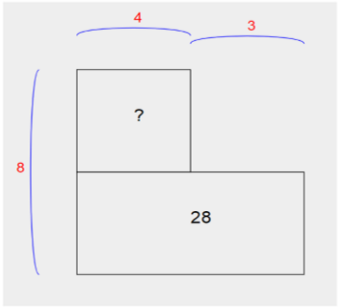
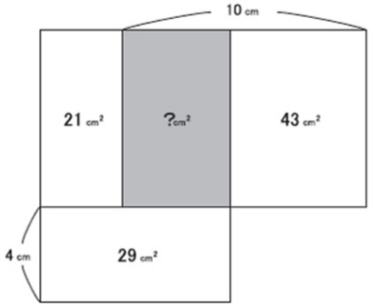
"I can't do Area Maze Puzzles… Yet."



What did you think about?
What did you do?



What could you think about?
What could you do?

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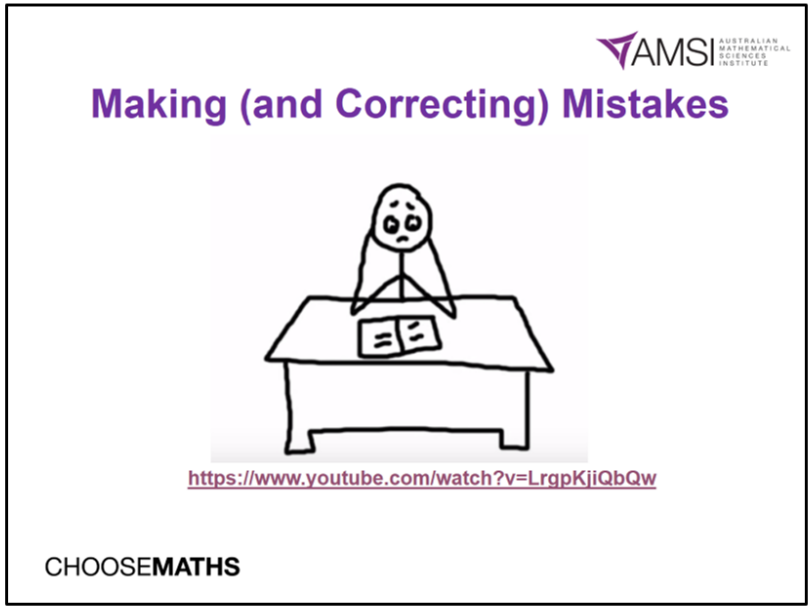
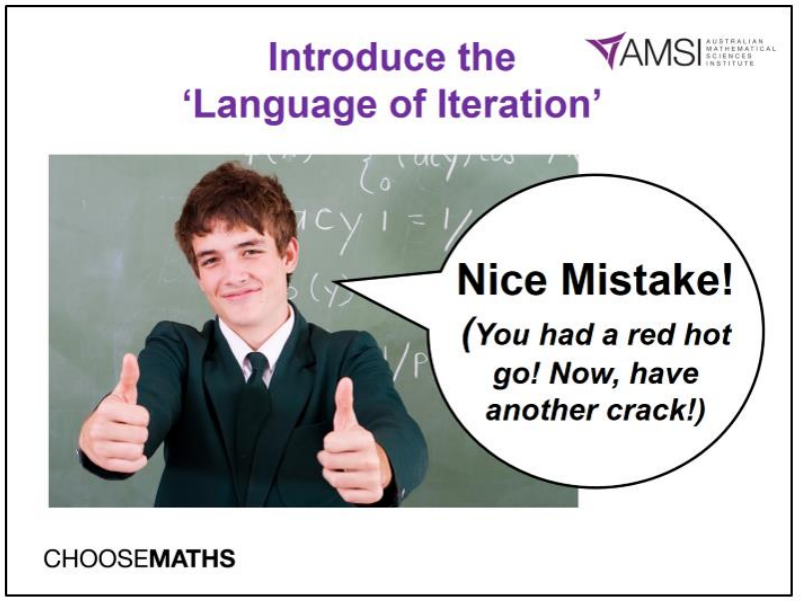
Thoughts…





So, why are mistakes important to a 'growth mindset'?

Briefly, it's because when we make an error and have to process where we went wrong, the brain makes far more synaptic connections than when we 'cruise through' a problem without having to think too hard!

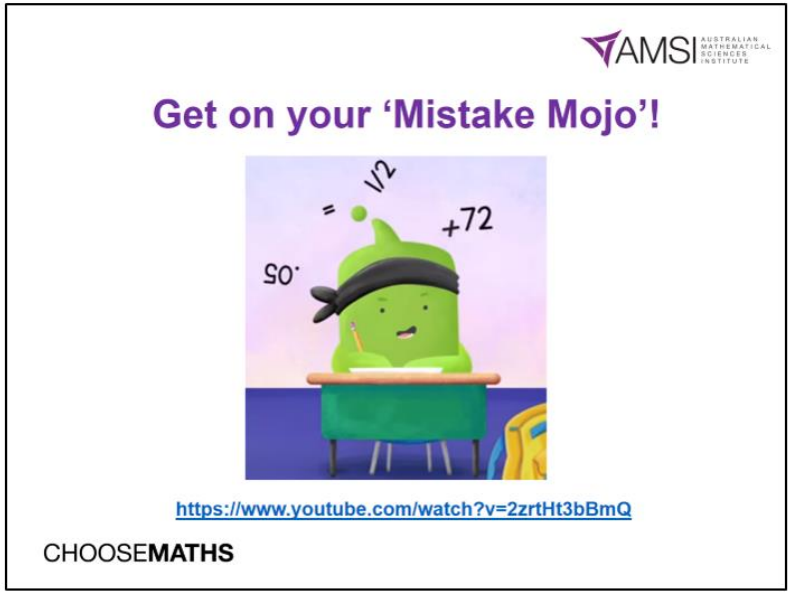
Here's what Jo Boaler has to say about mistakes and Growth Mindset…

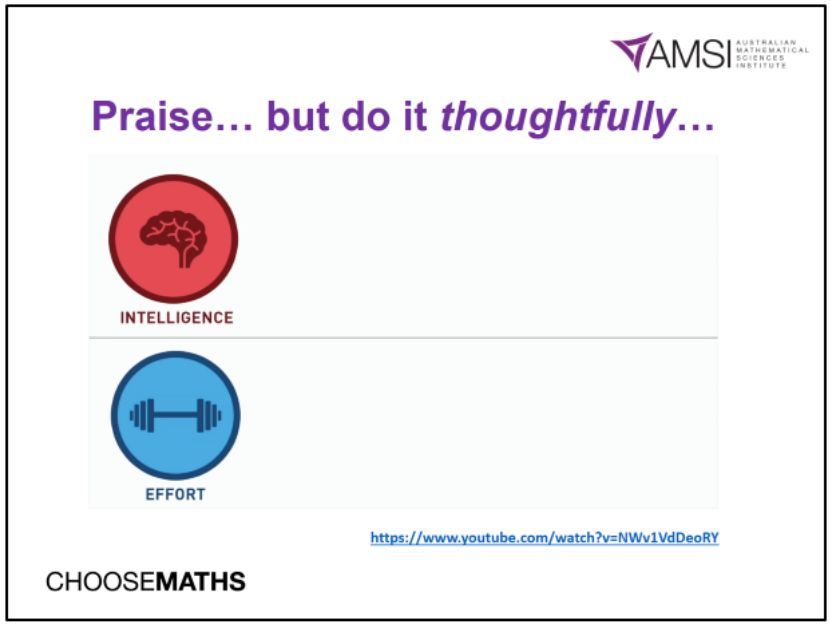
An overt acceptance of 'mistakes' in the classroom - if you like, call it 'iteration' (ie, the repeating of trial and error, learning from what hasn't worked in the past, to gradually improve what we do in the future) – can actually help students to embrace the learning opportunities that stem from errors.

An important caveat, however, is that we encourage students not to give up following an error, but to interrogate the error so that they understand where they may have gone wrong.

This may take some students only one or two goes – and others will take many more, and much longer. That's fine! 'Fast Maths' is not the same as 'Good Maths'!

In addition, providing students with a fully worked solution will only expand students' 'Zone of Proximal Development' if they can compare it against their own efforts – and errors.





For younger primary students, the attached YouTube clip provides a great explanation of the importance of mistakes, and of persevering to 'growing our brains' in mathematics…

Praise is also a very important catalyst for students developing a growth mindset in subjects such as mathematics. However, the praise given really does need to be the 'right kind' of praise!

In one of Dweck's studies, a group of year 5s were given a set of moderately difficult problems to work on.

All were told upon their completion, "Wow. That's a really good score!" They were then divided into 3 groups:

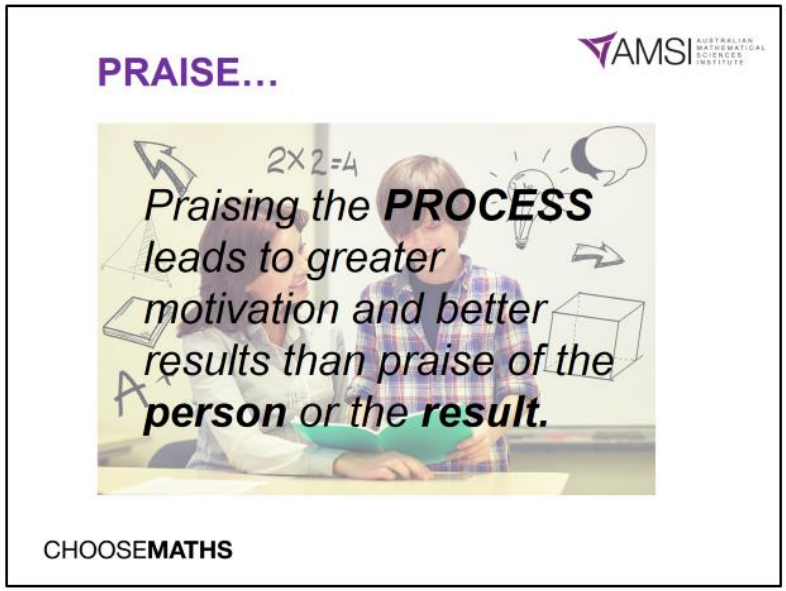
Group 1 were given no further comment.
Group 2 were also told, "You must be smart at this." *(Intelligence praise)*
Group 3 were told, "You must have tried really hard." *(EFFORT Praise)*

Students were then all given the option of doing a similar set or a more challenging set of problems.

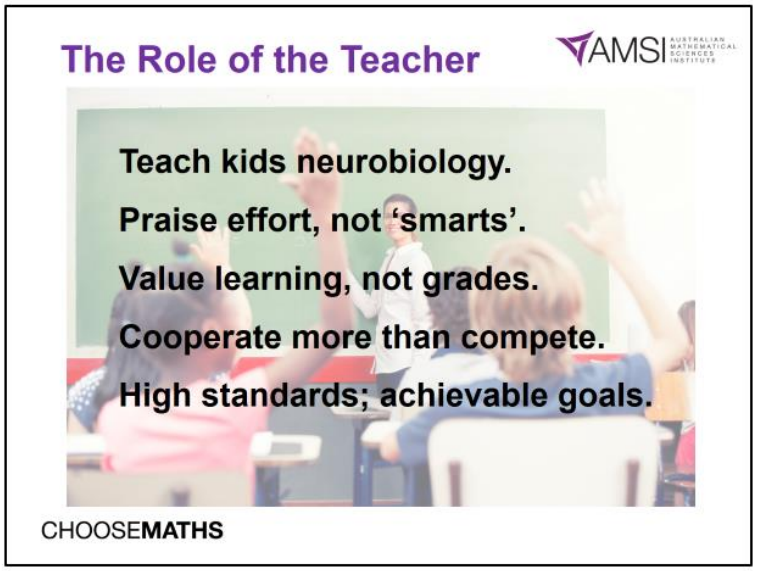
Guess which group of students were most likely to tackle the next set of more challenging problems?!

The results, including the control group, were as follows:.

1. Saying 'you got a good result' had no effect;
2. Praising **intelligence** *decreased* the next result; and
3. Praising **effort** *increased* the next result!



Dweck (and others) have carried out numerous studies that show that if you praise the PROCESS rather than the person or the result, the impact can be significant!



So, how can we best encourage a 'Growth Mindset' in our own mathematics classrooms?

1. Teach your students some neurobiology. The research shows that struggling and making mistakes 'grows' the brain. Students who know this achieve better results. Also, teach them about 'growth mindset', explicitly.
2. Practise praising the effort and process rather than the intelligence or result
3. Help students focus on and value the **process of learning.** Without this emphasis on learning, students will often base self perceptions of intelligence and worth to grades received, promoting a fixed mindset. While grades can be important, ***the value of learning should be prioritized***.
4. Design classroom activities that involve *cooperative*, *open* tasks rather than competitive or individualistic work. Research suggests that students are more motivated and successful when working in groups. Students will experience the positive feedback loop of effort and success, encouraging the development of a growth mindset.
5. Set high standards but help students develop achievable goals

10 Growth Mindset Statements

What can I say to myself?

INSTEAD OF:	TRY THINKING:
I'm not good at this.	1 What am I missing?
I'm awesome at this.	2 I'm on the right track.
I give up.	3 I'll use some of the strategies we've learned.
This is too hard.	4 This may take some time and effort.
I can't make this any better.	5 I can always improve so I'll keep trying.
I just can't do Math.	6 I'm going to train my brain in Math.
I made a mistake.	7 Mistakes help me to learn better.
She's so smart. I will never be that smart.	8 I'm going to figure out how she does it.
It's good enough.	9 Is it really my best work?
Plan "A" didn't work.	10 Good thing the alphabet has 25 more letters!

(Original source unknown)

@sylviaduckworth

More Information

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Teacher Resources

http://calculate.org.au/

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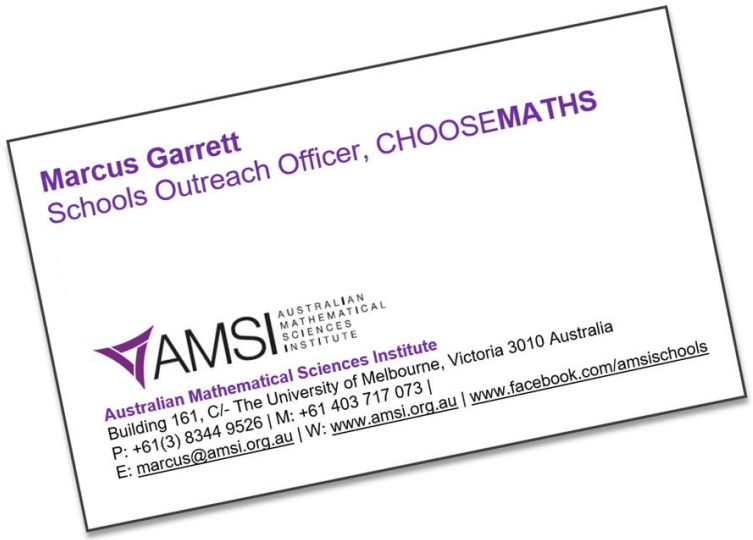

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