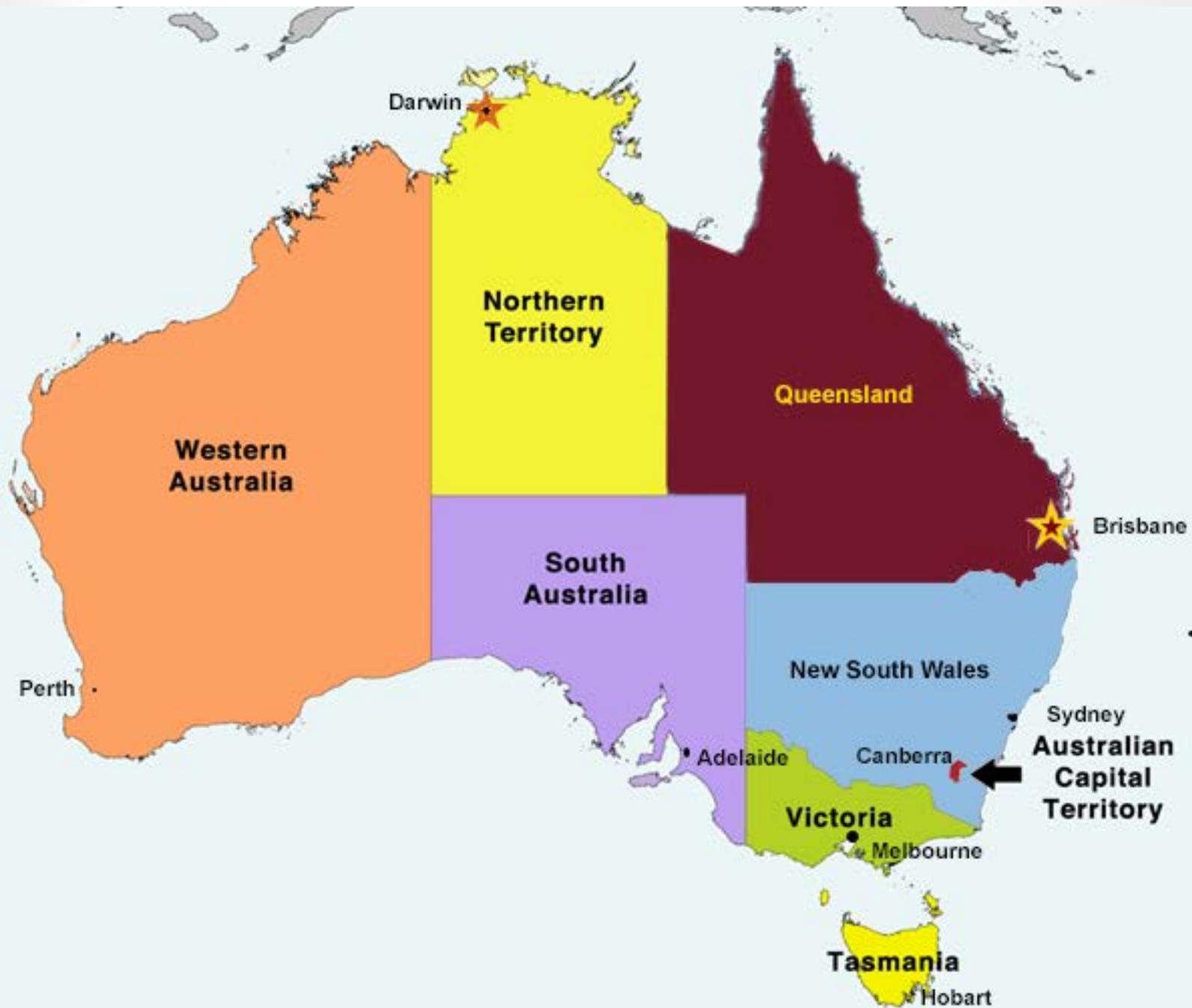


Contextualising learning in STEM: A realistic pathway for teachers of gifted students.

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A Personal Reflection





Questions

- Why do some gifted students reach peak performances at school and others don't.
- Gagne's DMTG proposes that motivation and environment as important "catalysts" that facilitate transformation.
- Domain-specific gifts are transformed into achievement in a learning process that is moderated by non-cognitive and environmental influences.
- Motivation and environment are reciprocally dependent.

Purpose of this Presentation

- I will explore three contemporary issues:
 - STEM – Science, Technology, Engineering and Mathematics. Relevance for the gifted.
 - Challenging underachievement: Motivation and Task Commitment – a theoretical perspective
 - Optimising teaching practices with the needs of the gifted in STEM – both cognitive and affective



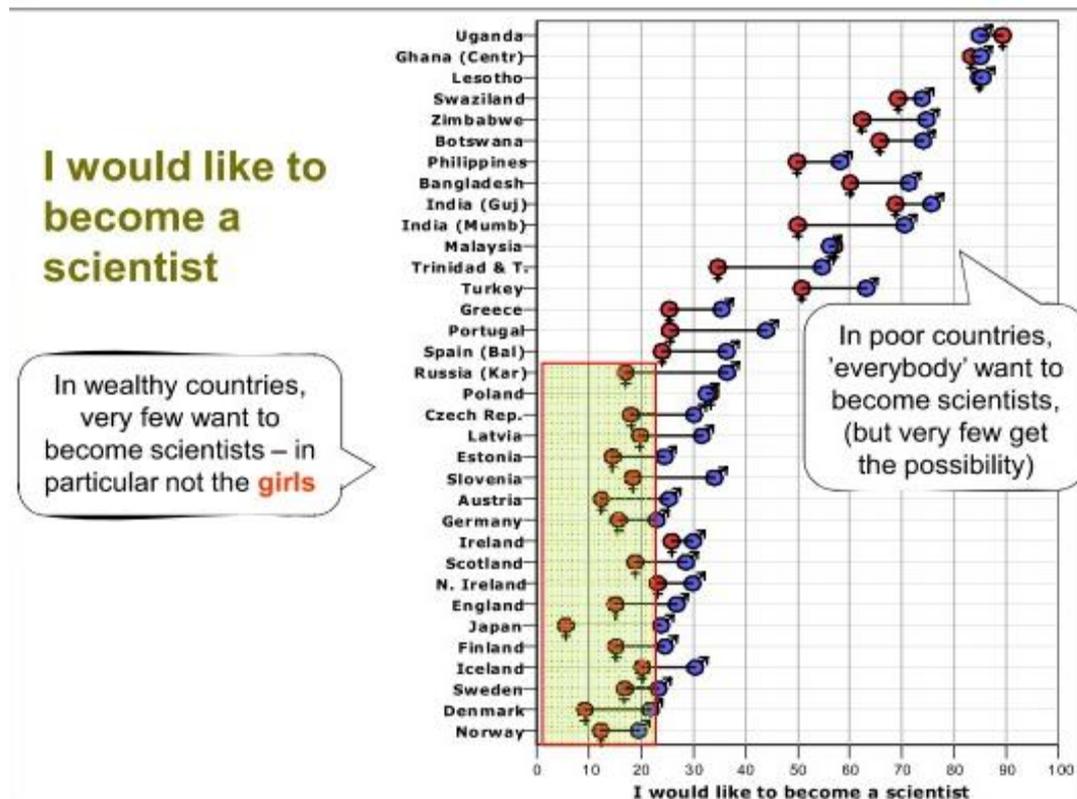
Science-Technology-Engineering-Maths

Population growth;
Food and water supply;
Sanitation;
Pandemics;
Energy supply;
Climate change.



Who will generate the solutions?

- Student attitude to, and performance in Science are negatively correlated
- Relevance of Science Education Study (ROSE) 15 year-olds





- TIMSS data – emphasises the symptoms not the problem;
 - Grade 4 Science: 69% of students said teaching was engaging,
 - Grade 8 Science: 47% of students said teaching was engaging;
- The origins of the declining interest among young people for science studies are found largely in the way science is taught in primary and secondary schools (EU Commission, 2007)
- Students with a high cognitive potential for science may not pursue careers as scientists or engineers because they have lost interest during school;
- Interest level and course of interest development depend on the perceived attractiveness of curriculum content.



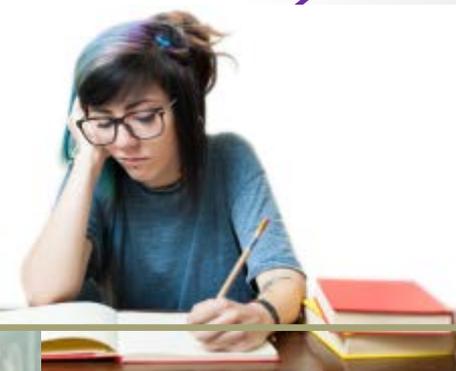
What are the Characteristics of the Scientifically Gifted?

- Epistemic curiosity;
- Collectors – pattern seekers;
- Tinkers – constructors and de-constructors;
- Abstract organisation of ideas;
- Strong visualisers;
- Mathematical cast of mind;
- Exceptional reasoning ability.



Underachievement

Alienation



Disengaged

14 years



Functioning at advanced level

5 years



Avid interest in reading, maths, complex vocab



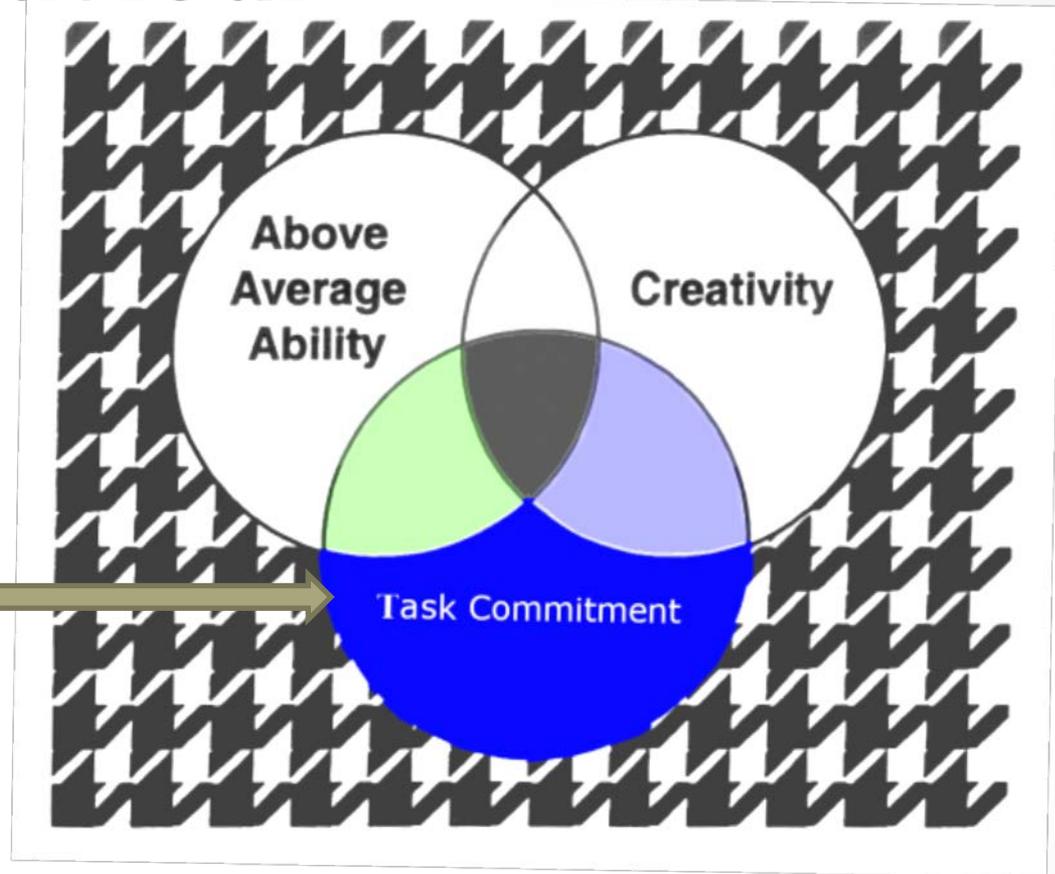
First words, curious & keen to explore

Attentive within days of birth



Gifted Behaviour

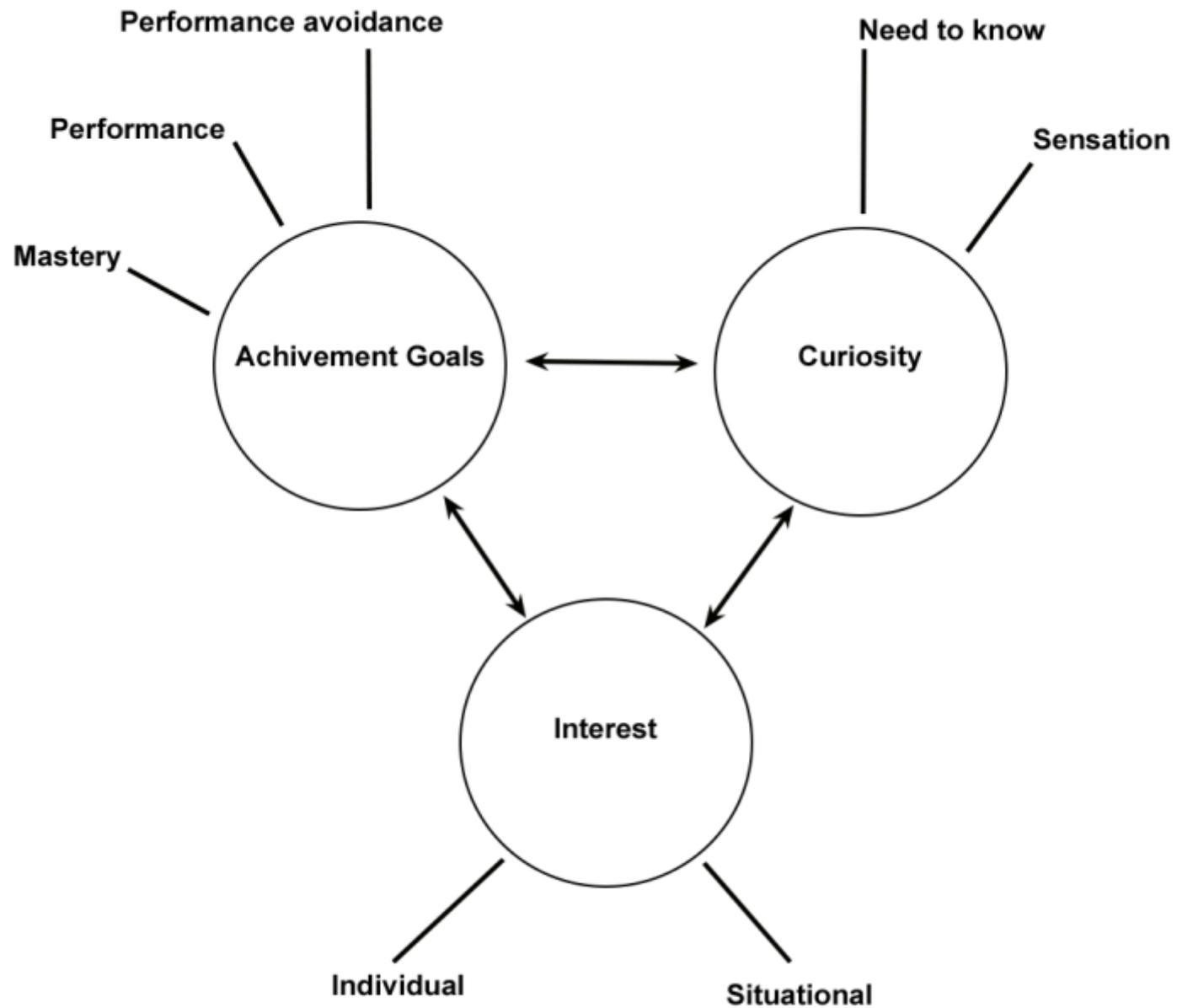
Engagement





Motivating Engagement

- **Drivers for engagement**
 - Expectancy for Success – likelihood of worthwhile outcomes
 - Task value – Why engage – importance of the task
- **Conditions for engagement**
 - Sense of autonomy;
 - Choice, options, negotiations, self-rule.
 - Sense of competence;
 - Propensity to pursue challenges.
 - Sense of connectedness;
 - Positive and productive relationships.
- **Outcomes**
 - Emotional Satisfaction – sense of wellbeing
 - Academic achievement





- *The important thing is not to stop questioning. Curiosity has its own reason for existing. Albert Einstein*
- *Curiosity, the overwhelming desire to know, is not characteristic of dead matter. Nor does it seem to be characteristic of some forms of living organism, which, for that very reason, we can scarcely bring ourselves to consider alive. Isaac Asimov*
- *If one has failed to develop curiosity and interest in the early years, it is a good idea to acquire them now, before it is too late to improve the quality of life. Mihaly Csikszentmihalyi*

Curiosity



Curiosity is a tendency to notice, seek, value, and embrace novelty, uncertainty, and challenge.

It is a desire to specific information in the absence of external reward.

It is nothing short of a miracle that modern methods of instruction have not yet entirely strangled the holy curiosity of inquiry.

Albert Einstein 1949



Curiosity

Sensation, Pleasure,
Goose bumps

High

Aesthetic appreciation

Passion - Flow

Congruity

Incongruity

High

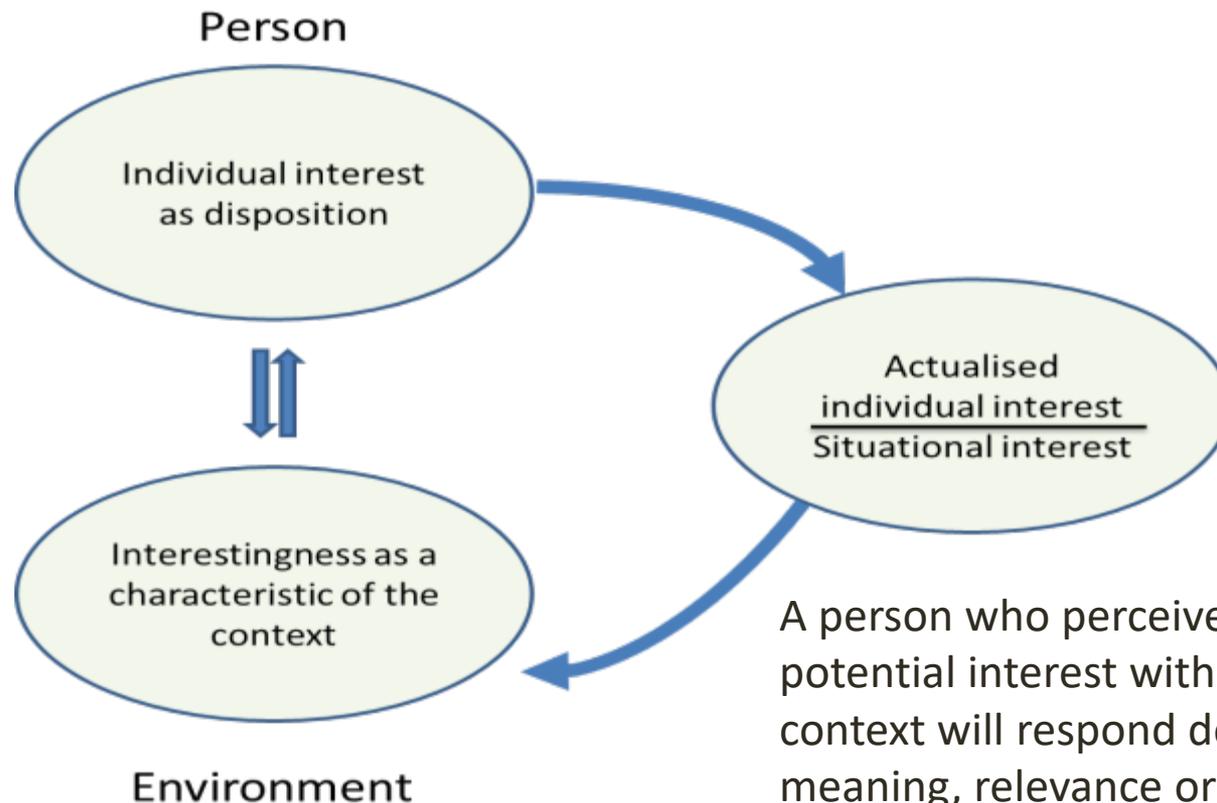
*Indifference
Avoidance
Amotivation*

Fear/Anxiety

*Impulsivity
Addictions*

Interest

Unexpectedness, ease of comprehension and level of challenge in a task **triggers** students' situational interest



A person who perceives an object of potential interest within a social context will respond depending on the meaning, relevance or value that object has to the person and their sense of self (Ainley & Ainley, 2011).

Year 6: Design a mini-golf links



Maths embedded in Sport

- <<VIDEO REMOVED>>

Designing a Golf Course Lesson

- Australian Curriculum
 - Mathematics: Measurement and Geometry Strand
 - Achievement Standard: Students solve problems using the properties of angles.
- Content
 - Identify corresponding, alternate and co-interior angles when two straight lines are crossed by a transversal (ACMMG163)
 - Investigate conditions for two lines to be parallel and solve simple numerical problems using reasoning (ACMMG164)
- Resources
 - Australian Curriculum Links: Angles Lesson – design your dream mini-golf course
 - Playing the virtual Golf Game (<http://jmathpage.com/>)

Active Learning Experiences

The objective of the teacher is to create a learning conducive and friendly environment that encourages everyone to participate in the discussion and share his or her knowledge.

- Learning that is relevant, real, and intentionally interdisciplinary;
 - Transparent” learning and assessment climates;
 - Tuning into students’ wonderings and affective experiences;
 - Learning that is self-regulated and autonomous is fostered.
 - Transformative classroom management.
-
- Inquiry learning;
 - Investigations;
 - Project based learning;
 - Problem based learning.



To establish a place of work where engineers can feel the joy of technological innovation, be aware of their mission to society, and work to their heart's content. Masaru Ibuka (co-founder of Sony) cited in Csikszentmihalyi (2004), *Good Business: Leadership, Flow, and the Making of Meaning*.

Google identified five key predictors of successful teams: psychological safety, dependability, structure and clarity, meaning of work, and impact of work. It noticed that the team dynamic found to have the most significant influence on team success was **psychological safety**, which is how comfortable team members are in sharing ideas and being vulnerable with one another.

Of course, while it may seem that enabling employees with such loud **voice** will make unanimity impossible to achieve, there's a greater value in recognising the difference in people rather than stifling the diversity. (Friedrich, T., 2015. *The Conversation*)

Concerns

- Takes too much time to plan and implement,
- Does not provide scaffolds for students who do not have the requisite knowledge;
- Doubts about prior knowledge or skills to be successful;
- Is not conducive to students acquiring the required content because it is not explicitly taught;
- Aligning with standards and syllabi.

Whole Class Examples

- Grade 5 Creek watch study
- Grade 6 Designing a mini-golf links
- Grade 7 Athletic performance Usain Bolt
- Grade 8 Terraforming Mars



Year 5: Creek Watch

- Increased urban development in the Western Suburbs of Brisbane is threatening the quality of the local environment. In particular, runoff is impacting on water quality and visible signs such as rising salinity and blue-green algal blooms are becoming more prevalent. ...
- Mrs. Jones from the EPA said the students' assistance had been invaluable and the information they provided helpful. "By monitoring the waterways we can gain a picture of catchment health. ...
- Jack Simpson's class is presenting their information at a community meeting where other interested groups are presenting their conclusions. The meeting organisers are offering a prize for the group that develops the best system that describes the most important criteria in establishing the total water quality of a creek.



Year 8: Colonising Mars

Year 8 students explored the problems of outfitting the colonisation of Mars with particular reference to living animals and plants.

During the next 15 years, a vast network of fully enclosed biospheres will be built on Mars. Groups interested in establishing a colony are invited to apply to the Working Committee for the Colonisation of Mars



- What sort of insects and plants would survive on Mars?
- What materials would be useful for insulating dwellings?
- How would lifestyle change if adapting to a Martian environment?

Outcomes

- Deeper and longer lasting understanding;
- Higher order skills of problem posing, critical analytical skills and creative insights;
- Social skills;
- Communications skills;
- Enhanced sense of self-efficacy and self-esteem;
- Improved attitudes to teachers and school.

Gifted

- *The whole art of teaching is only the art of awakening the **natural curiosity of young minds** for the purpose of satisfying it afterwards.* Anatole France *Le Crime de Sylvestre Bonnard* (1896) (Nobel Prize in Literature 1921)

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