

# Examining the 'STEM' conundrum: myth, crisis or something in-between?



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# 'STEM' skills – essential for success?



# Overview

- Study aims & methods
- Findings from the literature
- Definitions
- STEM education metrics
- O\*Net
- 'STEM' focus & skills



## Aims of study

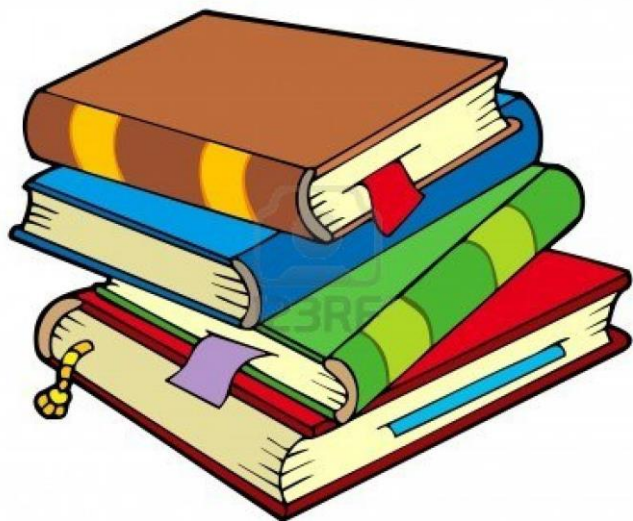
Frame a consistent definition of 'STEM' knowledge and skills

Identify the place of 'STEM' skills in a holistic skills framework

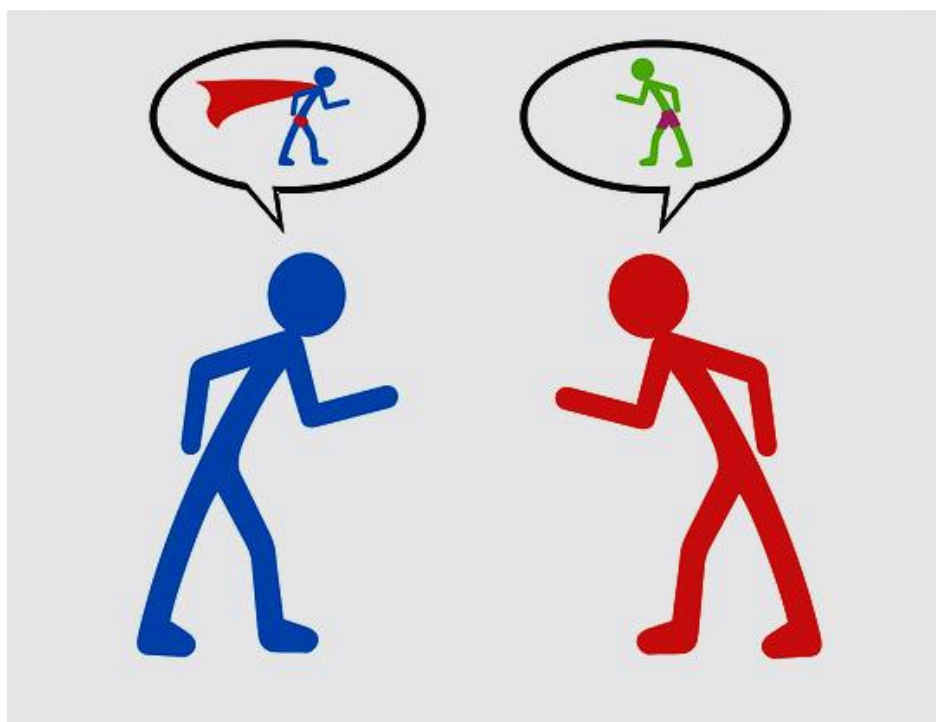
*Highlight 'STEM' knowledge and skills in VET education and VET workforce*



# Methodology



# Current 'STEM' debate



# Defining 'STEM' skills

- Mix of
  - technical/task skills,
  - 'soft' skills
  - higher-order cognitive skills
- Focus
  - Education
  - Workforce (Economy)
- Definitions
  - Interdisciplinary, meta-disciplinary, integrated
  - Discipline or subject specific



# Conceptual definition of STEM education

- STEM taught and applied
  - A) traditional and discipline specific
  - B) interdisciplinary and integrated
- Outcome focussed
  - To solve real world challenges
- Investing into human capital
  - Technical and scientific skills
  - Critical and creative thinking skills



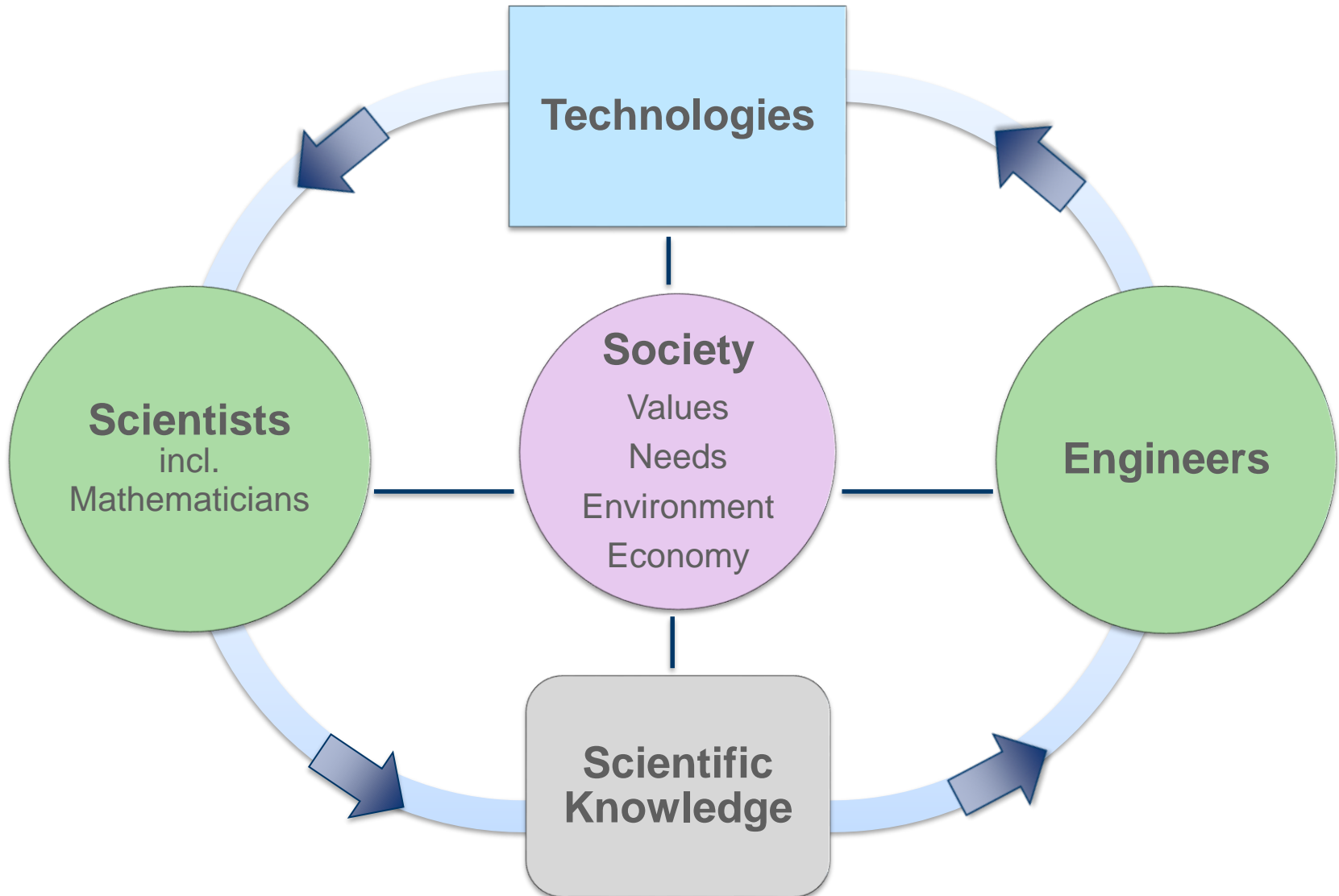
- Teachers/Educators,
- Scientists, engineers and digital specialists
- Technologically proficient workers
- Literate citizens



# Defining STEM skills & knowledge

- STEM is an acronym / a new term
- Interdisciplinary
- Aim of enhancing people's competency
  - in work and/or life
  - to protect and improve societal demands on technology
- Technical and task related skills
- Difficult to measure directly
- Approximated by subject or discipline specific skills





# Example for STEM skills

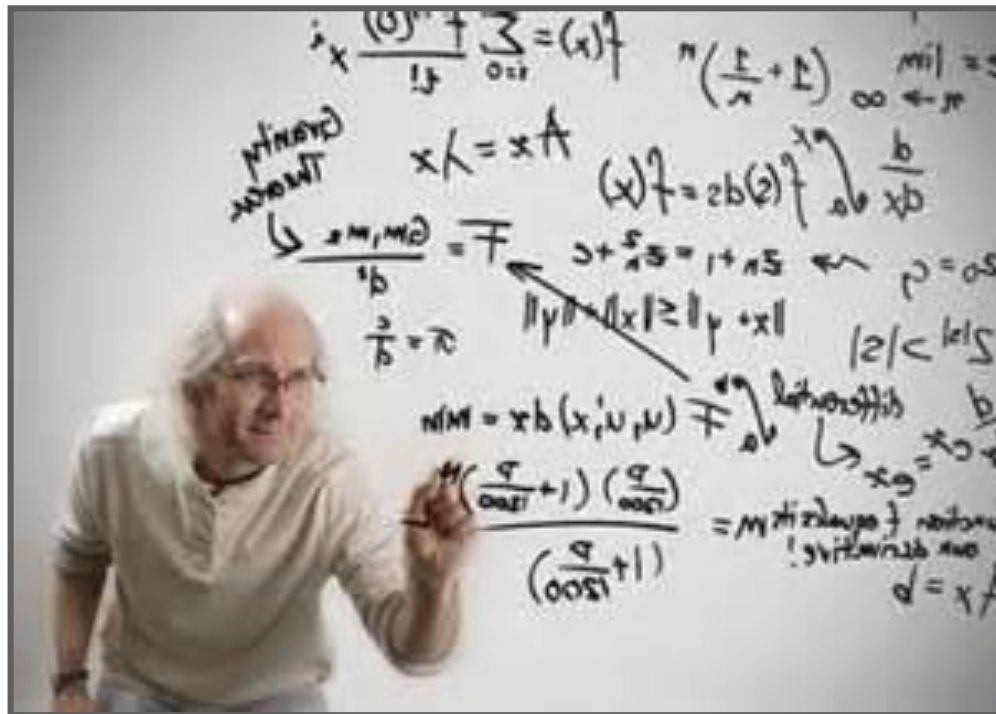


# Defining S.T.E.M. skills & knowledge

- S.T.E.M. is a collective term
- Full discipline names preferred
- Single disciplinary / discipline specific
- Value free
- Technical and task related skills
- Measurable by subject or discipline specific standard classification



# Example for S.T.E.M. skills



## Data driven definitions

- Field of education/study – ASCED/ISCED
- Level of education/study – ASCED/ISCED
- Occupation - ANZSCO
- Derived and applied ‘STEM’ categories?



# Field of Education Classification

- 01 **NATURAL AND PHYSICAL SCIENCES**
  - 02 **INFORMATION TECHNOLOGY**
  - 03 **ENGINEERING AND RELATED TECHNOLOGIES**
  - 04 ARCHITECTURE AND BUILDING
  - 05 **AGRICULTURE, ENVIRONMENTAL AND RELATED STUDIES**
  - 06 HEALTH
  - 07 EDUCATION
  - 08 MANAGEMENT AND COMMERCE
  - 09 SOCIETY AND CULTURE
  - 10 CREATIVE ARTS
  - 11 FOOD, HOSPITALITY AND PERSONAL SERVICES
  - 12 MIXED FIELD PROGRAMMES
- 

# ASCED - 'Field of Education' detail

<b>03</b>	<b>ENGINEERING AND RELATED TECHNOLOGIES</b>		
	<b>0301</b>	<b>Manufacturing Engineering and Technology</b>	
		030101	Manufacturing Engineering
		030103	Printing
		030105	Textile Making

<b>06</b>	<b>HEALTH</b>		
	<b>0601</b>	<b>Medical Studies</b>	
	<b>0603</b>	<b>Nursing</b>	
	<b>0605</b>	<b>Pharmacy</b>	
	<b>0607</b>	<b>Dental Studies</b>	
	<b>0609</b>	<b>Optical Science</b>	
		060901	Optometry
		060903	Optical Technology
		060999	Optical Science, n.e.c.





## Data example 1:

- Number of enrolments in VET qualifications
- VET provider collection, publically funded training
- AQF Certificate III and higher

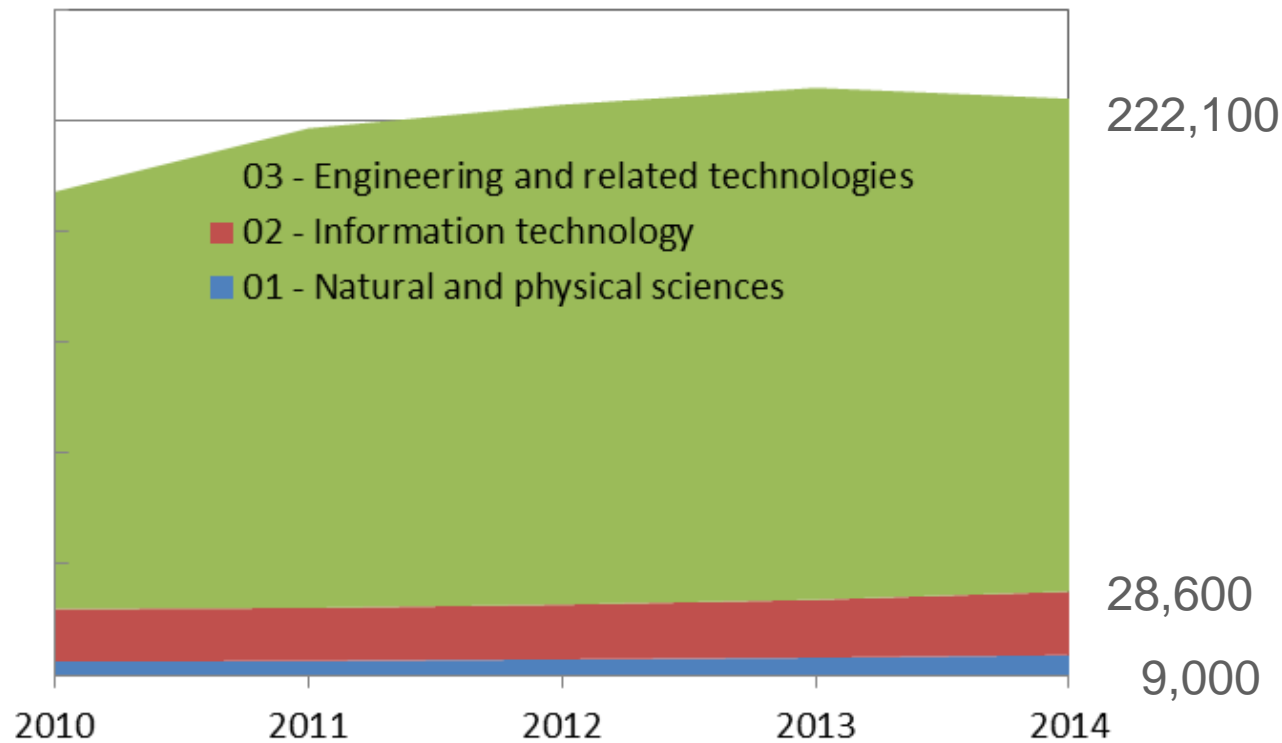
Case A) ASCED major fields 1-3 -> core 'STEM'

Case B) ASCED major fields 1-6 -> extended 'STEM'



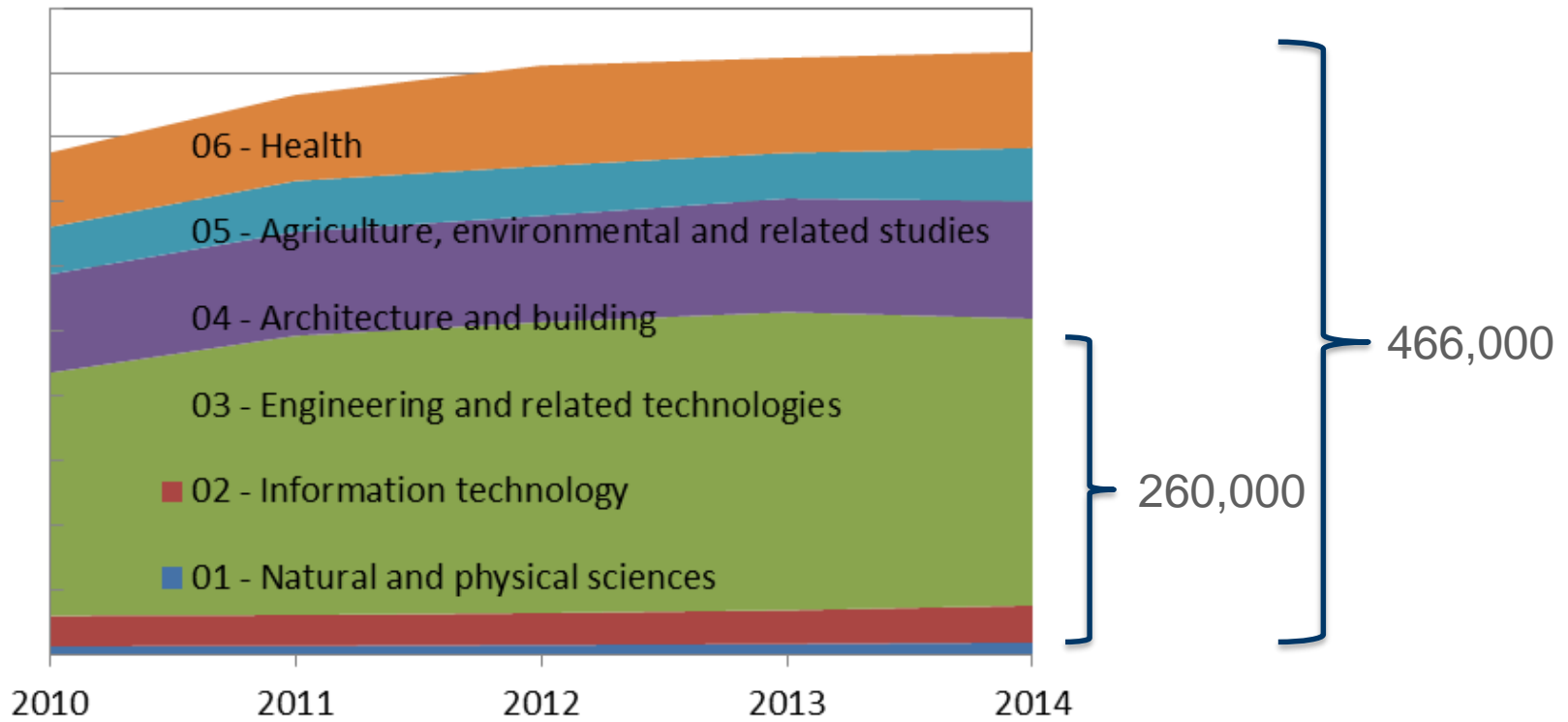
# A) TP qualifications in 'core STEM'?

260,000 'STEM' enrolments in 2014?



## B) TP qualifications in 'extended STEM'?

466,000 'STEM' enrolments in 2014?



## Data example 2: people with 'STEM' qualifications

Org	Data source	Field of education	Level of education	Number of people	% of total population (>15 yrs, 2011)
ABS	ABS Survey of Learning and Work 2010-11	NPS, IT, ETRS, AERS	AQF Cert III and higher	<b>2,718,300</b>	<b>15%</b>
NILS	ABS Census 2011	NPS, IT, ETRS	AQF Bachelor and higher	<b>651,000</b>	<b>4%</b>

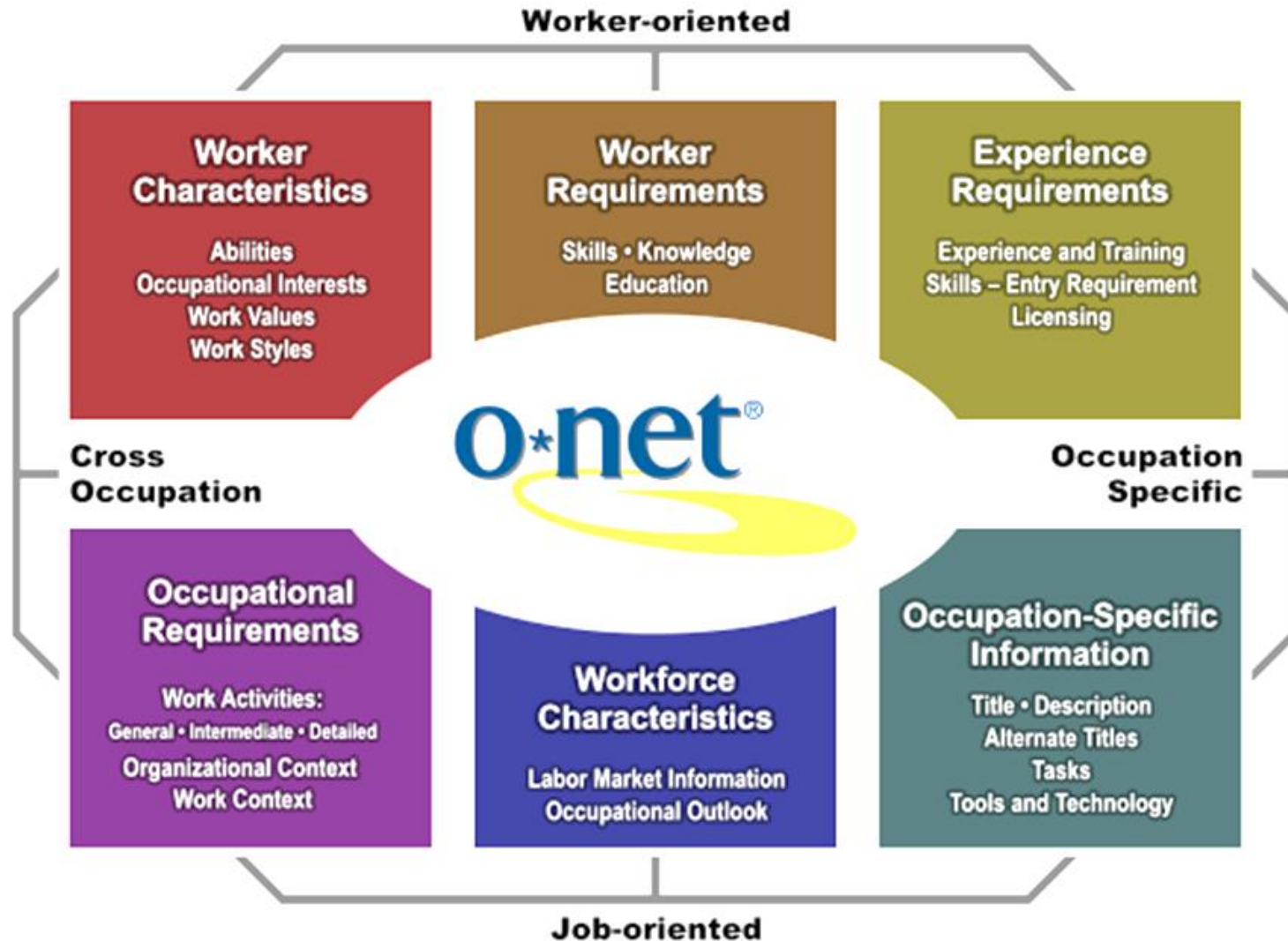


# Identifying STEM occupations

- Field of education qualification
- > 50% in ANZSCO occupation
- Top occupations (100% - 51%)
  - *Medical & Nursing\**
  - ICT
  - Engineering & Technicians
  - Scientists
  - *Education professionals\**



# O\*Net



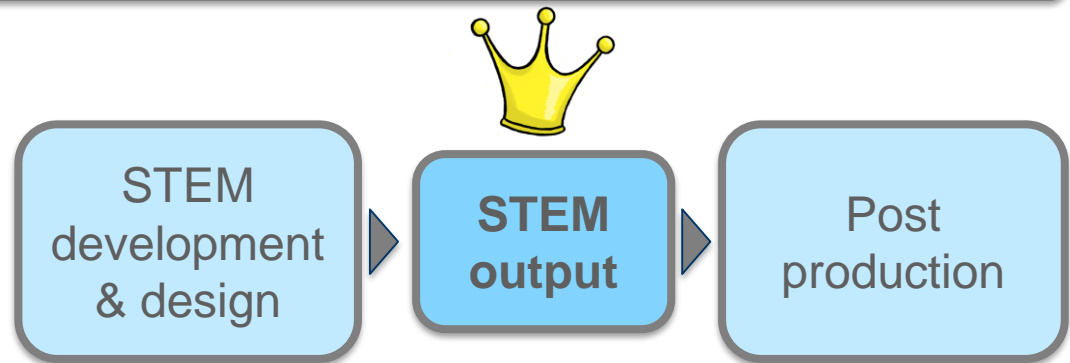
# Holistic skills framework

- Employment/workplace orientated
- 21<sup>st</sup> century skills
- Combination of different skills
  - COGNITIVE
  - SOCIO – EMOTIONAL
  - TECHNICAL (STEM, S.T.E.M. skills part of!)



# A different 'STEM' approach

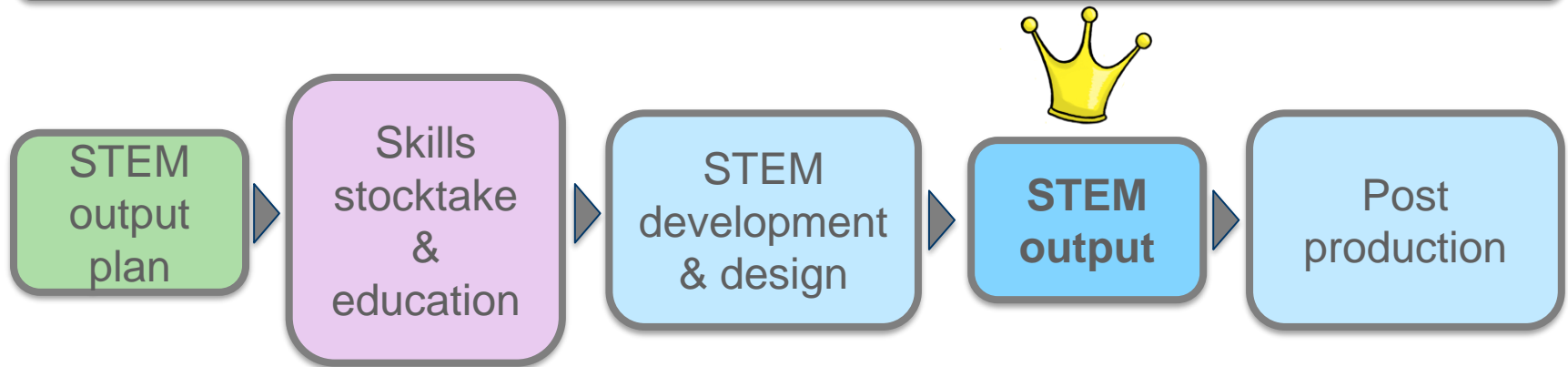
Economy, Politics, Society....





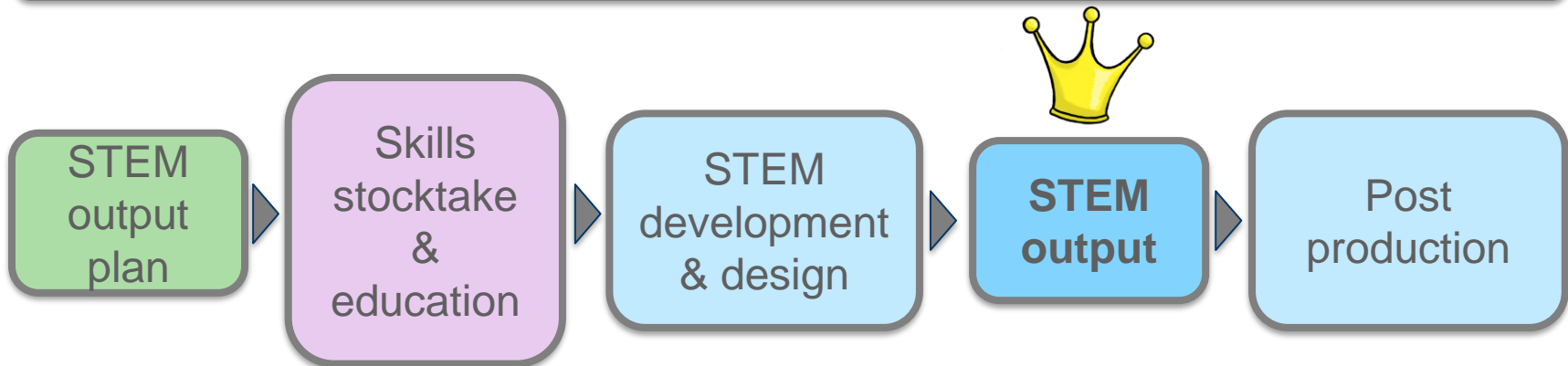
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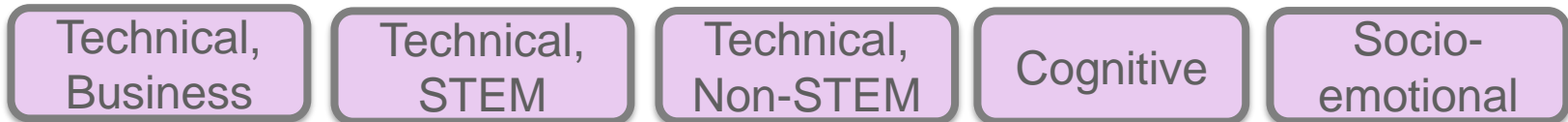


# A different 'STEM' approach

Economy, Politics, Society....



Variety of skills & knowledge



## TAFE SA 'Solar Spirit'



# The Flow Beehive



## Summary

- Most 'STEM' descriptions vague or too broad
- Interdisciplinary STEM skills  $\neq$  S.T.E.M. skills
- Improve descriptions of jobs  $\leftrightarrow$  O\*NET model
- Need holistic skill framework for work & outputs
- VET strong in
  - foundational literacies
  - industry collaboration
  - applied research & technology



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