

Putting STEM Education under the microscope

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Australian Government

OFFICE OF THE
CHIEF SCIENTIST

Over the next five years, employment is predicted to increase in professional, scientific and technical services by 14 per cent and in health care by almost 20 per cent. The Australian Bureau of Statistics has estimated that some STEM-related jobs, such as ICT professionals and engineers, have grown at about 1.5 times the rate of other jobs in recent years. ¹

The (STEM) fields and those who work in them are critical engines of innovation and growth: according to one recent estimate, while only about five percent of the U.S. workforce is employed in STEM fields, the STEM workforce accounts for more than fifty percent of the nation's sustained economic growth.



MATHEMATICS, ENGINEERING & SCIENCE
IN THE NATIONAL INTEREST



MAY 2012

Nearly half of Australian jobs are at risk of computerisation and automation, the Federal Government's latest report on the future of the workforce has found.

In 20 years, you will probably be a casual worker and your office will be shared with strangers — that is if a robot is not doing your job.

Minister for Employment Michaela Cash launched the report in Sydney yesterday, which found 44 per cent of Australian jobs were under threat.

She said it was time to "embrace the change".



PHOTO: In the next 20 years, 44 per cent of Australian jobs are at risk of computerisation and automation. (AFP: Toru Yamanaka)

CSIRO: The future of work

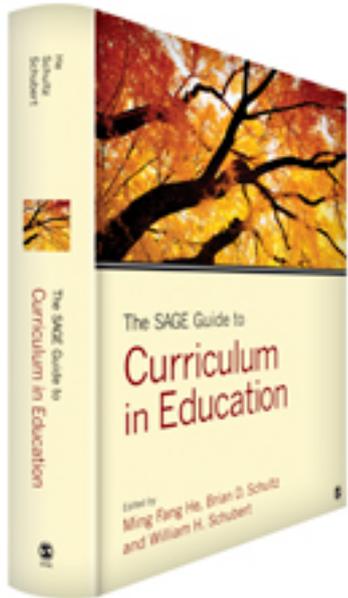
- **New skills and mindsets are needed for the future**
- Education and training is becoming ever more important
- New capabilities are needed for new jobs of the future
- Digital literacy is needed alongside numeracy and literacy
- The changing importance of STEM (whilst participation rates are in decline)
- ...

The current education system teaches people to be effective in a highly structured system, but Australia's future workforce is likely to encounter much ambiguity and openness. For this reason, commentators argue that our future educational system will need to do more to encourage innovative, entrepreneurial and flexible mindsets.

"We have an economy in transition and we need to upskill our current workforce to they can anticipate the jobs of the future," The report found there would be more demand for people with science, technology, engineering and mathematics knowledge in future. They are the sectors with the biggest increases in job numbers and wages.



A shift in the meaning of “STEM”



STEM as a curricular category has different meanings in different locations and policy documents. It is sometimes used as a catch-all term for scientific and technical disciplinary areas.

In the current Common Core State Standards in the United States, STEM has taken on the particular meaning of an integrated approach to science, technology, engineering, and mathematics that grounds educational experiences in the problem-solving and design processes central to engineering disciplines.

In general, STEM might be taken as an opportunity to seriously consider the alignment of school experiences with the distinct and/or integrated experiences with scientific and engineering practices in the “real world.”

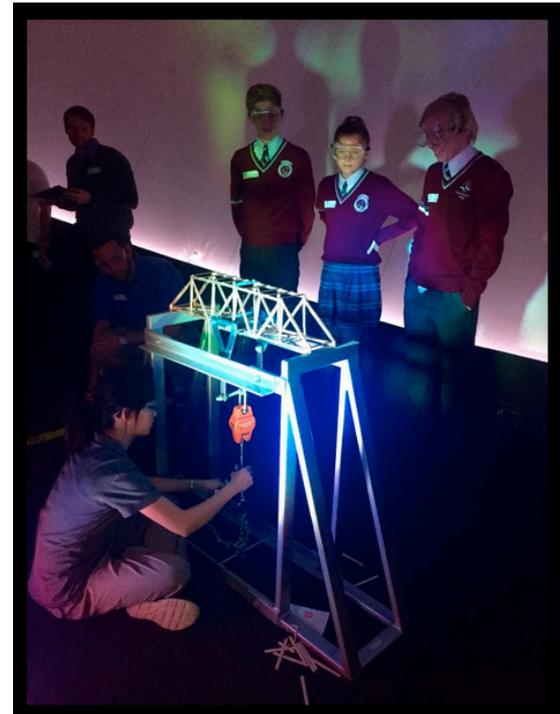
Tytler, R., Swanson, D.M., & Appelbaum, P. (2015). Subject matters of science, technology, engineering, and mathematics.



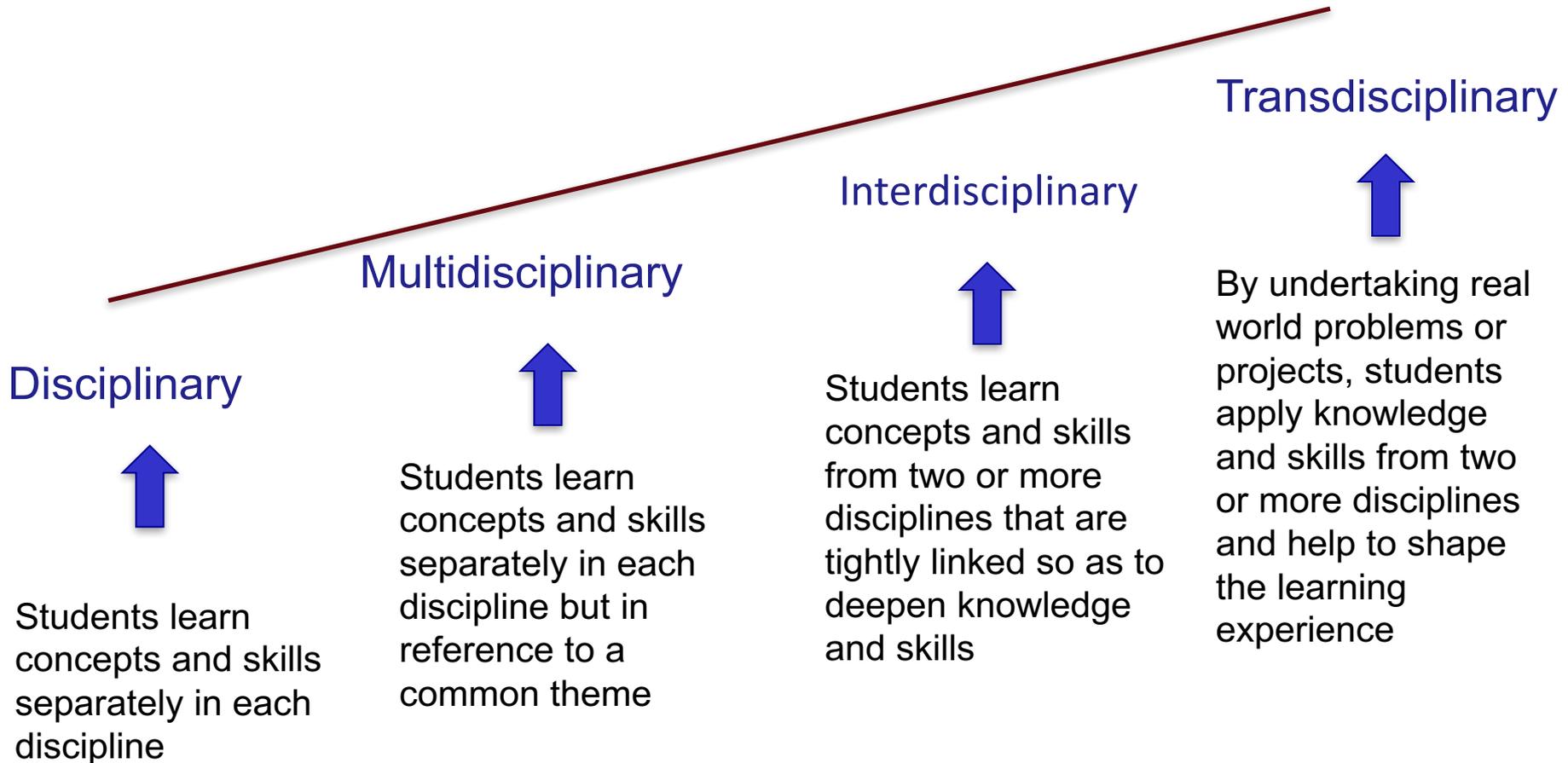
Focus of STEM advocacy

- Engagement
- Developing agile problem solvers and inquirers
- Authentic problems
- Innovation and creativity
- Design
- Digital literacy

How should we think of STEM capability?
How do we build a developmental curriculum?

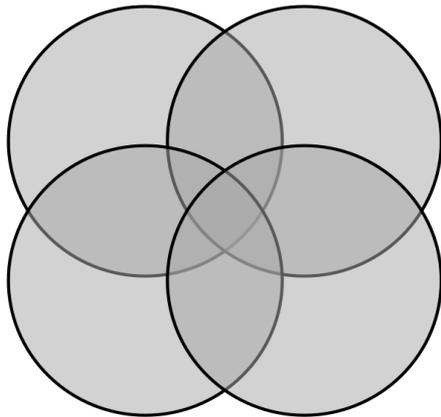


How is STEM to be conceptualised?



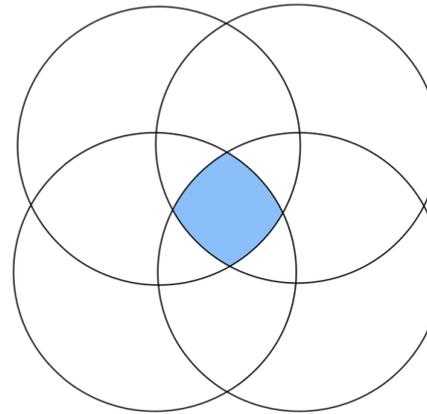
Framing STEM: STEM education

What can it be? For whom? For what purpose?



Holistic Model:

representing all disciplinary and interdisciplinary activities



Almalgamated model:

representing a meta-discipline

Vasquez (2015) describes STEM, not as curriculum, but

“as an approach to learning that removes the traditional barriers separating the four disciplines and integrates them into **real-world, rigorous, relevant learning experiences for students**” (p.11).

Alternative models of STEM education

Is STEM a coherent discipline? Where are its boundaries?

Arguments for STEM +

STEM

STEMM

STEAM

ESTEM

STEM-HASS

What can we say is common, when different disciplines have different epistemic bases – different ways of producing knowledge, different conceptual tools, different evidence bases.



Interdisciplinary STEM in schools?

- **Curriculum policy**
 - Variability across Australian states
 - Do we need one model or many?
 - How do we write this into the curriculum?
 - How do we measure the outcomes?
- **In schools**
 - Enthusiasm for engaging students
 - Some enthusiasm but serious challenges for cross subject teacher collaboration
 - Concerns about the integrity of disciplines
- **For teacher educators**
 - Have we been here before?
 - How do we support teachers?
 - How might we productively lead the conversation?

The program for today

- 2 pm Russell Tytler: Overview of STEM policy environment and outline of the plan for the afternoon
- 2.10 Linda Hobbs – report on the STEM Education conference and work in schools
- 2.25 Richard Lehrer: Perspectives on Integrating Elementary STEM Education
- 2.45 Peter Fensham: An historical perspective on STEM as a schooling goal
- 3.05 Groups discussion and response
- 3.30 **Coffee break**
- 3.50 Julian Williams: Situating STEM within a Funds of Knowledge perspective on problem solving
- 4.10 Günter Törner: Business communities supporting STEM innovation in German schools
- 4.30 Groups discussion and response
- 5.00 Plenary: Towards a position paper on the opportunities and challenges in the current focus on STEM
- 5.30 **Canapes and drinks**

