

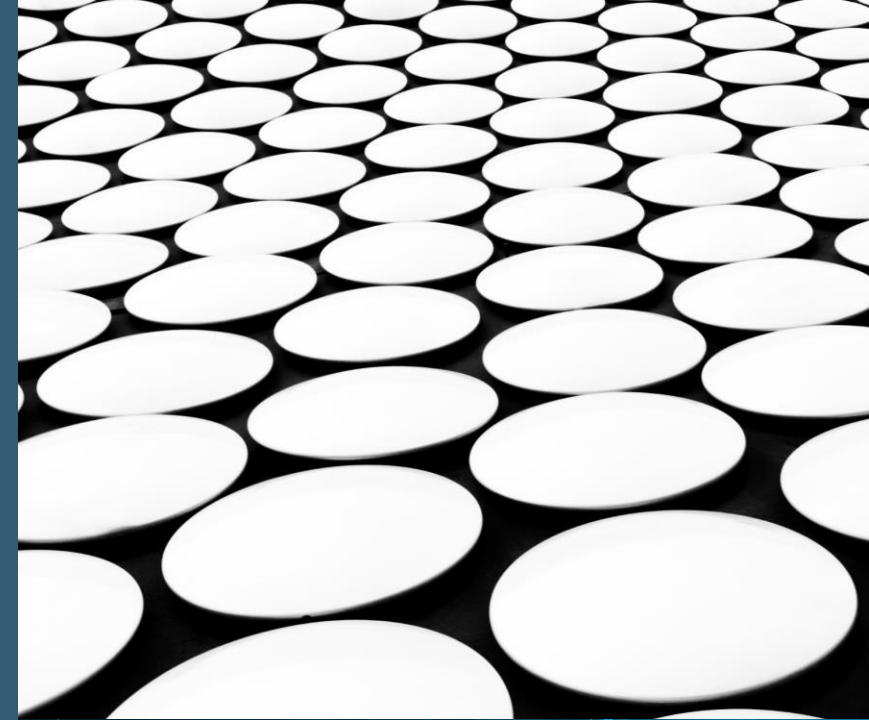
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# TEACHER DEVELOPMENT FOR POLICY CHANGE

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**ICoESE** 2022





#1 in the World Education  
QS rankings 2014-2022

## WHO AM I?

- *I have a background in mathematics, teaching, international teacher education and mathematics education policy, including in parts of Asia and sub-Saharan Africa. My mathematics education research focuses on the practice-policy interface, with a special interest in supporting mathematics education that is meaningful, equitable and empowering for all.*
- *I am currently based in London, at UCL IoE*  
<https://iris.ucl.ac.uk/iris/browse/profile?upi=JGOLD18>

# OUTLINE: WHAT POLICY CHANGE? WHAT TEACHER DEVELOPMENT?

*Part philosophical and analytical, part experience and empirically-based, building on Professor Kaur's lecture and drawing on*

- Work with TIMSS and PISA (as PI and mathematics subject specialist)
- Work for The Royal Society on [Mathematical Futures](#)
- Collaborative work with Pearson: a series of six longitudinal curriculum enactment studies in mathematics classrooms with students aged 5 to 18.
- Details of these can be found at [My profile](#)

# WHAT DO I MEAN BY MATHEMATICS?

- For me, mathematics is both discovered and invented, and mathematising an integral, absorbing, challenging and satisfying part of being human. Young people should experience that.
- Mathematics deals with the science and art of number, quantity, and space, either as abstract concepts (pure mathematics), or as applied to other disciplines such as physics or social sciences (applied mathematics)
- It draws on mathematical ways of working (including exploration, hypothesising, deductive and inductive reasoning, rigour..) to work with patterns and to solve intra- or extra-mathematical puzzles and problems, using mathematical dispositions such as curiosity, persistence, imagination, creativity ...
- As such, I believe it encompasses data science and many aspects of computational thinking, as well as a core mathematical literacy (understood as **formulating, employing and interpreting mathematics in a variety of contexts**, reasoning mathematically and using mathematical concepts, procedures, facts and tools to describe, explain and predict phenomena).

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# WHY SHOULD WE TEACH MATHEMATICS? (WHO IN SOCIETY NEEDS WHAT MATHEMATICAL INSIGHTS AND COMPETENCIES, AND FOR WHAT PURPOSES? )

- Biesta's (e.g. 2015) education goals of qualification, socialisation, subjectification in order to achieve societal and personal thriving:

*Qualification: Education should equip for useful employment in society:*

- We need a *conceptual grasp* of relevant mathematics
- but the nature of the mathematics needed, and the tools used, are changing, for many:
- mathematical-techno literacies, confidence to estimate and interpret representations.
- data handling, and computational knowledge and skills for many –
- but also mathematical ways of thinking and of being: mathematical reasoning, communication, problem solving....
- Some still need advanced knowledge of pure mathematics (Wolfram?)



- **Socialisation:** equip for adult life in a 21<sup>st</sup>-century society: financial, digital literacies, but also core mathematical literacies around number and space (e.g. need to understand and critique arguments around covid, climate change....)
- **Subjectification:** personal thriving, that might include employment and social thriving, but also encompasses spiritual, cultural, character, physical and mental thriving. I'd argue that for many, mathematics contributes in a deep way to many aspects of that.



**AN ENHANCED ROLE  
FOR PLACE-BASED  
MATHEMATICS?**

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## GENERIC COMPETENCIES ALSO NEEDED ( '21<sup>ST</sup> CENTURY SKILLS')

- E.g. creativity, collaboration, communication, critical thinking, .. These need to be developed beyond silos: many problems cross boundaries – think climate change, global equity of opportunity....
- What does it mean to *master* mathematics, within and beyond mathematics itself?
- How should we account students' beliefs, attitudes, background experiences and knowledge, in their planned learning?
- **And what schooling structures, curriculum, pedagogies, assessment, teacher education would support doing all that well?**
- UNESCO 2021: REIMAGINING OUR FUTURES TOGETHER — A new social contract for education [unevoc publications \(unesco.org\)](https://www.unesco.org/publications/unevoc-publications)

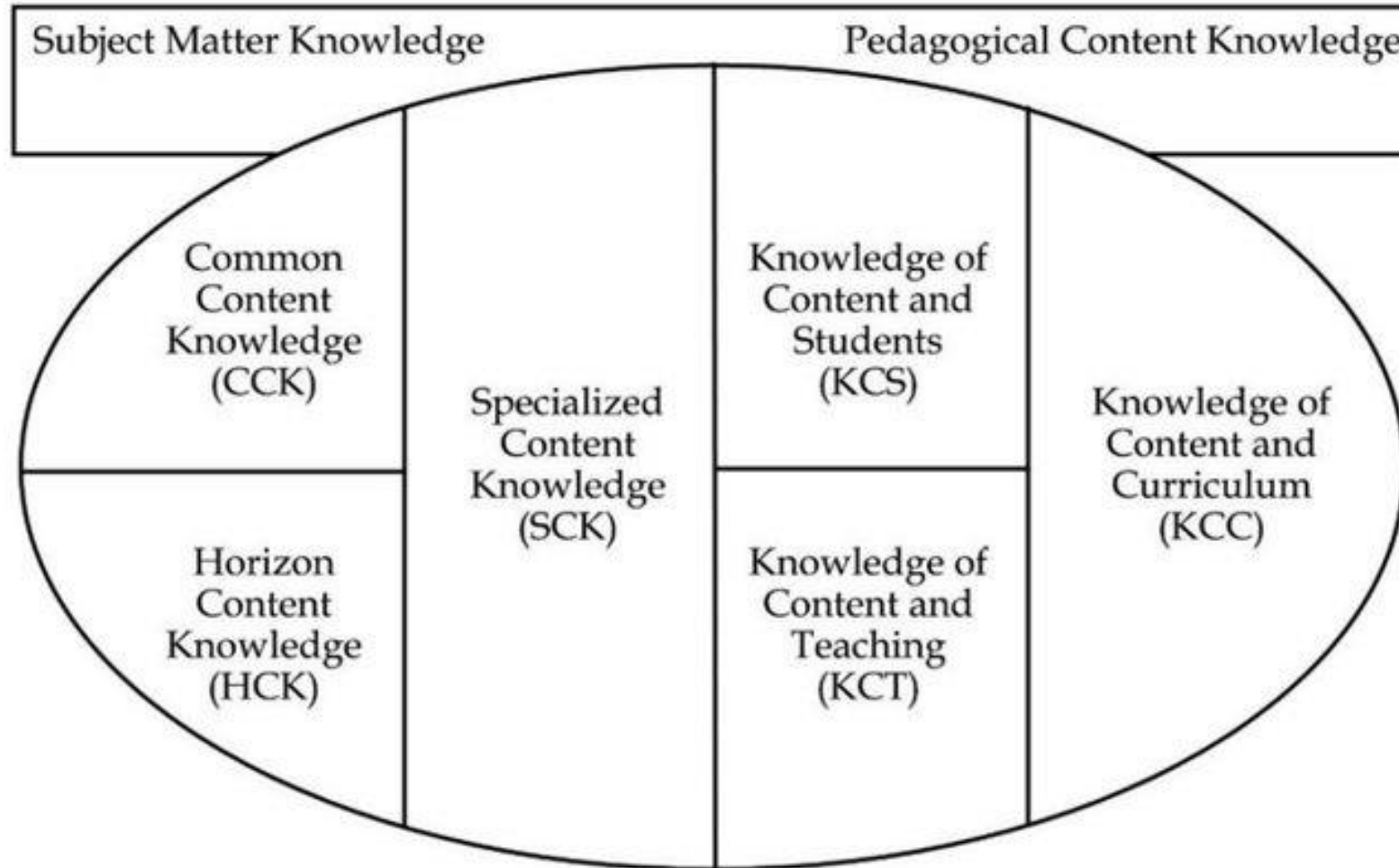




- **We need a coherent education system**
- **Schooling structures:** need to accommodate cross-disciplinary transfer and inter-disciplinary experiences and problem solving. But we have new resources and new ways of working: we should capitalise on those.
- **Curriculum** – might need to focus on mathematical, financial, data, digital, maybe computational literacies – but exploring elementary pure mathematics is also needed for human flourishing. Some need to use much more mathematics – and some to become mathematics specialists.

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- **Assessment** – must measure what is valued ([Redmond, Golding & Grima, 2020](#)). That might well mean moving away from traditional terminal summative assessments in limited time. Digital tools, some when-ready assessments, collaborative portfolios.... might be a small part of the answer
  - **Teacher education: How should we equip our teachers so as to ensure all young people have access to the mathematics education they need, as reflected in answers to the above questions?**
  - Teaching for 20<sup>th</sup> century mathematics education is hard
  - **Teaching for ambitious 21<sup>st</sup> mathematics education is even harder**
  - Needs to include deep mathematical (subject and pedagogical) grasp – see Ball's egg for subject-specific teacher education needed.

BALL, D. L., M. H. THAMES, AND G. PHELPS. 2008. CONTENT KNOWLEDGE FOR TEACHING: WHAT MAKES IT SPECIAL? *JOURNAL OF TEACHER EDUCATION* NO. 59 (5):389-407.



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## ENHANCING ACADEMIC CAPACITY IS NOT ENOUGH

- Such aspirations are challenging, but in themselves are insufficient for a world in which all flourish
- They require teachers to develop a deep practical wisdom ('phronesis') that can synthesise informed caring about students, their mathematics learning, and the full breadth of mathematics and its interactions with other disciplines and with the world around us
- Underlying all this, the positive impact of enhanced mathematical (or scientific, or technical, or other) academic capacity and functioning can be undermined by limits to our wisdom for living together
- We need to want to share, to be prepared to learn from one another across our cultures and contexts, and to be humble and wise enough to do so, if our children and grandchildren and their successors are to flourish



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# TEACHER DEVELOPMENT AND PROFESSOR KAUR'S LECTURE

- Singapore as a small, cohesive nation imbued with a Confucian culture, where almost all teachers of mathematics are mathematically well-equipped (have a deep grasp of elementary mathematics, its teaching and learning), and have a significant entitlement to PD each year. Each of those is an advantage when it comes to supporting pedagogical change
- PD for even 20<sup>th</sup> century skills requires content focus, coherence, duration (interleaving with practice), active learning and collective participation
- Professor Kaur points to the potential for hybrid PD; there is some evidence remote structures can support SK learning, but that face to face is much more effective for SPK (e.g. Golding & Bretscher, 2018)

# TEACHER DEVELOPMENT FOR POLICY CHANGE

- Education policies should change to meet changing mathematical needs for the 21<sup>st</sup> century.
- Teacher development for that is key.
- There are well-known limits to ‘cascade’ models of PD (DES, 1988), although it is scaleable and affordable; effective PD needs serious investment in expert teacher education
- **We need to start from where we are. Being too ambitious is counter-productive.** Aiming for evolution (to include enhanced conceptual grasp), rather than revolution, in teacher practice, is much more likely to be achievable and sustainable.
- **Hybrid learning** offers good potential, but so too do high quality teacher-educative curriculum materials (Davis & Krajcik, 2005), used with a focus on content focus, coherence, duration (interleaving with practice), active learning and collective participation (e.g. [Barrow, Golding & Grima, 2021](#))



- **We have learnt during the pandemic** that computers cannot replace teachers,
- but there are other sources of authority that can be drawn on in the (remote or in-person) ‘classroom’
- **We do not yet know how to equip our teachers to teach for an ambitious 21<sup>st</sup> century education**
- But hybrid, subject-focused, collaborative and sustained teacher learning, supported by expert continuing teacher education, offers promise.

*Thank you for  
listening*

I should be pleased to  
discuss these issues  
with you at  
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