Engaging young people with STEM: A science capital approach

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Policy Context

• Lots of time and money has been invested in efforts designed to engage more young people with science
• But little change in participation rates and participation profile – which remains narrow/privileged
• Many efforts have sought to make science more ‘fun’ and ‘interesting
• But lack of interest is not the main problem ...
ASPIRES research

• Since 2009 the ASPIRES project has undertaken large-scale surveys (40,000+ young people to date), and in-depth tracking of 50 students and their parents (age 10-21) (700+ interviews)

• Student surveys and interviews at ages 10/11 (Y6), 12/13 (Y8), 13/14 (Y9), 15/16 (Y11), 17/18 (Y13) and age 20/21

• Lack of interest in science is not the main issue ...
Most like science - but few aspire to be scientists

Comparison of survey responses from Y6, Y8, Y9, Y11, Y13 students
(% strongly/agreeing)

* Only asked of Y13 students studying at least one science A level
** Y13 data is weighted to national A level science entries
What careers do students aspire to?

% Y11 students agreeing would like this job

- Business: 60%
- Design: 30%
- Arts & design: 30%
- Celebrity: 30%
- Teacher: 30%
- Medicine/doctor: 30%
- Sports: 30%
- Law: 30%
- Engineering: 30%
- Inventor: 20%
- Trades: 10%
- Scientist: 10%
- Hair/beauty: 10%
Key factors shaping science aspirations and participation age 10-19

Full (2019) report:
https://discovery.ucl.ac.uk/id/eprint/10092041/15/Moote_9538%20UCL%20Aspires%2020report%20full%20online%20version.pdf
Science capital – what is it?

• Developed in Aspires project and extended in Enterprising Science project

• ‘Science capital’ is a ‘conceptual holdall’, combining habitus, cultural and social forms of capital

• Nationally, about 5% of 11-15 year olds have “high” science capital and 27% “low” science capital

• The more science capital a student has, the more likely they are to aspire to and participate in post-16 science and have a ‘science identity’
Main dimensions of science capital

1. Science literacy (“what you know”)
2. Science-related attitudes and values (“how you think”)
3. Out of school science behaviours (“What you do”)
4. Science at home (“who you know”)

Interactions of *habitus*, *capital* and *field* produce patterns in science engagement and participation:

- **Habitus** - socialised, embodied dispositions shape whether science is ‘for me’, or not, formed through classed, gendered, racialized experiences: Gives a ‘feel for the game’

- **Capital** – cultural, social economic and symbolic resources possessed and accrued, shaped by social axes: the ‘hand’ you can play in the game

- **Field** – ‘space of positions and position-taking’: the ‘rules’ of the game

Extent of ‘fit’ between habitus, capital and field shapes whether students experience science/STEM as a ‘fish in water’, (Science families – where science is ‘for me’), or not and produces differential trajectories
An analogy

**ENGAGEMENT** = burning flame (produced at interface of habitus, capital and field)

**HABITUS & CAPITAL** = candle (‘fuel’): socialised dispositions, and (science-related) economic, social and cultural resources

**FIELD** = air and conditions around the candle (oxygen, wind, etc) Influences if and how the candle burns (e.g. how bright, how long, flickering or steady)

Teacher = heat
‘High’ and ‘low’ science capital families

• A note on terminology (“high”/ “low”) and dangers of deficit interpretations

• Produces sense of whether science is for ‘people like me’, or not

“The other day in the car we were laughing about chemical symbols and things, so I guess it does come into the discussion quite subliminally really” (Mother, white middle class).

“Science is just where it’s at in my family” (Davina, white, middle-class)

“I suppose in everyday life you don’t get that much to do with it [science]” (Mother, white, working class)

“They never talk about science” (Jack, Black, working-class)
The field – supporting or limiting the realisation of science capital

• Value of a person’s science capital is determined by the field
• Different fields provide different affordances (or limitations) for young people to see themselves and be recognised by others for their science engagement (e.g. Carlone study of a US middle-school class over time)
• Field plays key part in cultivation of science capital over time and creates the feel for whether ‘science is for me’ or not

• Bound up with association of science with cleverness

• E.g. Victor (white, middle-class boy, goes on to Astrophysics degree):
  
  Y6: “You don’t have to be clever to do science”

  Y8: “I think you have to be a little clever ... yeah, you probably have to be quite clever”

  Y9: “People keen on Science ... um they’re sort of ... they’re not average people, they’re more ... they’re more clever, they’re cleverer than most people”

  Y11: “Er, yeah, you need it, yes”
As a result ...

• Many, even highly interested, young people are stopped/hindered in continuing with science
• Many self-exclude (“science is interesting, but not for me”)
• Those who continue are the most stereotypical in their views of science ...
Influence of science capital

- Useful explanatory concept for entrenched participation patterns
- ASPIRES longitudinal sample: 80% of those who never aspired to science had low science capital. 83% of those who continued post-18 had high science capital
- Students with high science capital are more likely to express positive views of all STEM areas and aspire to continue with STEM
- Science capital is particularly predictive of participation in physics (high SC 7.8x more likely) and engineering (3.2x more likely) but less strongly related to maths and computing
- But is still one factor among many
What can a Science Capital approach offer STEM outreach and public engagement work?

• Framework for understanding issues of differential engagement
• A reflection tool for informing practice
• An evidence-based, pedagogical framework (“the science capital teaching approach”) for building science capital
Supporting ISL engagement

• It's not (just) what you do - but the way that you do it!
• Underpinning values and mind set will determine the equitable potential of your practice and use of the SCTA
• Two elements: the Compass and the Model
Youth Equity+STEM project

• Four year UK/US project
• Funded by Wellcome Trust, ESRC and National Science Foundation
• Focus on equity in informal STEM learning (designed & community) settings
• Focus on young people aged 11-14 from under-served communities
• Participatory working between youth, practitioners and researchers
• Eight ISL partners (3 x science centres, 3 x STEM clubs, community zoo, digital arts centre)
Equity Compass

https://www.youtube.com/watch?v=WE4ksRCEoyA
• 2 minute explanatory animation:
https://www.youtube.com/watch?v=WE4ksRCEoyA

• Summary publication for practitioners

• Applying with ISL educators (YESTEM project) and primary teachers (Primary Science Capital Teaching Approach project)
Compass helps us to:

• Recognise and think about 8 key dimensions of equity/social justice
• Use reflective questions to guide our thinking
• Consider how equitable practices and outcomes are
• Map where we are – and map our progress (moving from inside outwards)
Example: “Dr. Bridges”

• Visiting STEM professional doing one-off session with Y4 class
• Tells class a bit about his job
• “Can anyone describe what a bridge is?” Children give ideas
• Short powerpoint talk about the importance of bridges and what maintenance they require
• Tells them arched bridges are much stronger than flat bridges
• Runs hands-on lolly stick bridge activity – tells children to build one flat bridge and one arched bridge and see how many toy cars are supported on each
Evaluation

• Plus points: children increase their engineering content knowledge a bit; direct experience of meeting STEM professional; break from norm

• Minus points: children not very engaged or inspired; reinforced, rather than disrupted, existing, dominant power relations and stereotypes (e.g. of engineers/ engineering); did not support children’s agency

I think an engineer is a man who like is good at maths and science and needs to be like strong to make stuff

He was obsessed with bridges! I think he just really loved bridges.

It was OK I guess. But I’m not the most massive fan of bridges
Equity Compass

Dr. Bridges
(2) Adopting a science capital approach
Changing the field (‘air around the candle’)

The Science Capital Teaching Approach

• Social justice approach
• Builds on existing good teaching practice
• Works with any curriculum
• Key principles - improving students’ relationships with science, changing the field, not the young person
• Originally developed with secondary (Enterprising Science project), now being developed with primary (PSTT/Ogden project) and with the informal sector
Development of SCTA

• Originated in collaborative R&D work with secondary schools (over 4 years with 40+ teachers from schools in 4 cities)

• Evidence from 2x year long trials showed significant increases in secondary students’ science capital, attitudes to science and post-16 science aspirations

• Current project is co-developing the approach with primary teachers

• Also working with informal educators to refine and apply

• Focus on changing practice – not changing the young person (e.g. how engagement is organised, who has power, issues of representation, valuing what participants bring with them)
REFLECT on your practice

THE OUTCOME: Equitable science engagement

THE PILLARS OF PRACTICE:
- Personalising and localising
- Building science capital elements
- Meaningful eliciting, valuing, linking

THE ESSENTIAL FOUNDATIONS:
- Tailoring to the least engaged
- Starting with the child
- Levelling the playing field
- Promoting student voice and agency

THE BEDROCK: Good primary teaching

TWEAK your lessons
Foundation: Broadening what counts

• Young people do not just find science concepts difficult – some struggle to identify and engage with science, it feels alien to them

• Challenge stereotypes and dominant ideas and representations of science, such as ‘who does science’ and what constitutes ‘doing’ science
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<th><strong>Foundation: Broadening what counts</strong></th>
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<td><strong>Tailoring to the least engaged</strong></td>
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<td>Plan sessions from the perspective of a young person who seems often to not be very engaged and think about ways to make science more relatable for them</td>
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<td><strong>Start with/centre the participant</strong></td>
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<td>Instead of planning and starting a session from the point of view of a learning objective, start with what participants already know/care about/have experienced and how/why it might relate to their lives and what is important to them</td>
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<td><strong>Levelling the playing field</strong></td>
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<td>Create a learning environment where participants who do not have certain resources are not unnecessarily disadvantaged. Value wider ways of ‘doing science’</td>
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<td><strong>Supporting voice and agency</strong></td>
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<td>Create a learning environment where young people’s voices are heard and validated. Use their voices to direct the experience so that participants have ownership/agency towards the science topics, organisation and style of learning</td>
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Pillar: Meaningfully Elicit, Value & Link

• A technique for helping to broaden what counts and personalise and localise
• Way to support participants to feel valued and connected to science
• Educators elicit participants’ experiences, skills and home and cultural knowledge (what they ‘bring with them’) in relation to a topic, value (and legitimate) these, and highlight the science connections
Pillar: Building the science capital dimensions

• Actively cultivate, develop and build science capital dimensions

• E.g. build understanding of how science is everywhere in life; foster the sense that science isn’t hard, or for other people, but can be a part of everyone’s life and conversations.
Outcomes - secondary
Key features

• Approach has proved popular across primary, secondary and informal settings
• Trying to help move the focus away from ‘more STEM’ (esp. content knowledge), one-offs, deficit approaches
• Key to approach is embedding SC principles in everyday practice
• One-off visits have a place, but will not be as effective as participatory, focused, longer-term engagement.
• Using SCTA to support and develop young people’ critical STEM agency – taking action on issues that matter to them and their communities
• In conjunction with the social justice mind set (Compass)
Summing up

• The compass and SCTA can help us think about and enact equitable/socially just STEM engagement practice and help STEM and young people to more meaningfully connect

• Key point: changing practice (the field), not the young person

• Together, the resources provide tools for practice and can help track progress and support professional reflection and development

• Our projects will be publishing a range of resources, publications, etc., for the ISL sector over the coming year
THANK YOU

Any questions?
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Some further SCTA resources


ASPIRES publications (30+, thematically grouped)