Enterprising Science

Inspiring science learning with teachers, students and families

'Science capital': a summary for policymakers

Introduction

This is a brief summary of the first major academic paper[1] arising from the Enterprising Science partnership of BP, King's College London and the Science Museum Group. The paper has been submitted for peer review and can be made available to interested parties prior to publication.

The paper sets out a model for how we are defining science capital as science-related forms of cultural and social capital, provides insights into how science capital might be used as a transformative concept, and describes a survey tool for its measurement. It recognises that attitudes and aspirations towards science are shaped by complex and interrelated factors including experiences in and out of school, influenced not just by teachers but also by parents and families.

The Enterprising Science partnership is trying to develop and test ways of creating conditions within which wider forms of science capital might be valued and enabled, particularly using the non-formal learning approaches of science museums and science centres, in order to help more young people from under-privileged backgrounds to find science relevant, engaging, and useful.

In this respect, we see science capital as a tool or device to help improve young people's lives and foster social mobility. We invite others to take a complementary approach and are sharing our emerging findings in that spirit.

Summary of findings

We report on findings from a survey conducted with 3,658 secondary school students, aged 11-15 years, in England. We found a clear relationship between a student's level of science capital and their future aspirations in the STEM subjects. This would suggest that there is an urgent need to raise the overall level of science capital, particularly to improve post-16 STEM participation rates.

Analysis found that science capital was unevenly spread across the student population and that levels of science capital are patterned by cultural capital, gender, ethnicity and school science set.

Science capital is unevenly socially spread and is strongly concentrated in more privileged social groups. Relatively few students (5%) possess 'high' science capital and around 27% are classified as having 'low' science capital. This has implications for young people's access to, participation in and engagement with science.

Significantly, our findings suggest that girls and those with low cultural capital are particularly likely to be over-represented among those students with low science capital who lack confidence in their science identities and feel that others do not see them as 'science people'.

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[1] 'Science capital': a conceptual, methodological and empirical argument for extending Bourdieusian notions of capital beyond the arts - Louise Archer, Emily Dawson, Jennifer DeWitt, Amy Seakins & Billy Wong, (under review)

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Science capital 'pen portraits'

Overall a picture emerged in which the likelihood of a student having a particular level of science capital appears to relate to their cultural capital, gender, ethnicity and school set. Cultural capital refers to non-financial social assets that promote social mobility beyond economic means – see 'Rationale' section below.

Students with high, medium or low levels of science capital also seem to have very different post-16 plans (regarding studying or working in and from science) and different levels of self-efficacy in science. We developed the following 'pen portraits' as an illustrative tool to help convey these patterns:

High Science Capital (5% of students surveyed)

Our survey shows that only a small proportion of students surveyed had high science capital. High science capital students are more likely to be male, Asian and come from the most socially advantaged homes, with very high levels of cultural capital. They are more likely to be in the top set for science at school and are interested in a science-related future career (e.g. 93% of high science capital students aspire to a science-related job, compared to 51% of the whole sample). These students are much more interested than other students in studying a science subject at university (50% of high science capital students vs. 19% of the whole sample) or at least to A-level (37% vs. 23% of the whole sample). They are confident in their science abilities and overwhelmingly secure in their public identity as a 'science person'.

Medium Science Capital (68%)

The majority of students surveyed were categorised as having medium science capital. They are largely representative of the wider sample in terms of gender, ethnicity and social background (although slightly more likely to have medium/higher levels of cultural capital and less likely to have lower levels of cultural capital). They are marginally more likely to report being in the top set at school compared to the overall sample. They are slightly more likely to be interested in pursuing science at A level and a science-related job compared to the overall sample, but are less interested in future science-related jobs than those with high science capital (and are more interested than those with low science capital). They have medium levels of confidence in their abilities but are not that secure in their science identity (less than a quarter of medium science capital students feel that others see them as a 'science person').

Low Science Capital (27%)

Over a quarter of the students surveyed fell into this category. These students were more likely to be female and to come from less socially advantaged backgrounds (possessing low or very low levels of cultural capital). They are more likely to be in the middle or bottom sets for science at school. They are noticeably less likely than other students to want to work in a science-related job in the future (20%, as compared with 51% of the whole sample). They are far less likely to want to pursue science post-16 – only 6% aspire to study a science subject at degree level and just 9% are interested in studying a science subject at A level. Students with low science capital are far more likely to want to drop science after GCSE (34% vs. 19% of the whole sample). They have little confidence in their science abilities and overwhelmingly do not feel that others see them as a 'science person'. These young people may find science interesting, but are particularly unlikely to consider post-16 science or careers from science as being 'for me'.

Rationale: Using science capital as a tool to increase social mobility

Capital is a key component within the French sociologist Pierre Bourdieu's theory of social reproduction. Bourdieu conceptualises capital as the legitimate, valuable and exchangeable resources in a society that can generate forms of social advantage within specific fields (e.g. education) for those who possess it.

Economic capital relates to money and financial resources, social capital refers to social networks and relations and cultural capital refers to qualifications, dispositions and cultural goods. Symbolic capital refers to those forms of capital that are accorded the highest social prestige and legitimation, and hence which may be the most powerful in accruing social advantage. These four forms of capital do not operate in isolation, but interact together to determine a person's position within any given field.

The middle-classes often successfully combine economic, cultural and social capital to produce academic achievement. While more prevalent among privileged groups, the deployment of capital to promote educational advantage is not solely restricted to the White middle-classes. Studies have indicated how middle-class and some working-class minority ethnic families may also strategically use cultural, social and economic capital to facilitate social mobility for their children through the production of educational attainment and strategic educational 'choices'.

If the value of science capital lies in the processes that make it valuable, then perhaps the key task for science educators is to act on these to create contexts within which different forms of (science) capital are valued, activated and able to be converted into symbolic forms of capital.

We are primarily concerned with how science capital might be used as a transformative concept. The Enterprising Science partnership is trying to develop and test out ways of creating conditions within which wider forms of science capital might be valued and enabled, in order to help more young people from under-privileged backgrounds to find science relevant and engaging, and to use this engagement to improve their lives. In this respect, we see science capital as a tool or device to help improve young people's lives and foster social mobility. That is, science capital is more a means to an end, rather than an end in itself.

In our paper, we take a broader view of scientific forms of capital. We suggest that science, technological, mathematical and engineering-related resources should be legitimately considered as important contemporary forms of capital which play a role in the production of social relations of advantage/disadvantage. This is not least because they command a high symbolic and exchange value within contemporary society.

Our starting point for the current work, to develop a first iteration of an index of science capital, is the belief that it may be interesting and useful (both conceptually and in practice) to be able to 'measure' and determine levels of science capital. This exercise may be of interest not only to researchers, but also for the myriad of science education organisations which deliver programmes and interventions designed to engage and inspire young people to better understand and/or continue with science.

Theoretical model of science capital

Our theoretical model of science capital combines the following:

- STEM-related cultural capital:
    - Scientific literacy – knowing key scientific concepts and how science works (e.g. "I know how to test a hypothesis", knowing how to use scientific evidence to make an argument)
    - Scientific-related dispositions/preferences (e.g. valuing of science in society, "it is useful to know about science in my daily life")
    - Symbolic science-related knowledge (e.g. about the transferability of STEM qualifications in the labour market., "a science qualification can help you get many different types of job")
    - Consumption of science-related media (e.g. watching science-related TV programmes, reading science-related books/magazines; online science consumption)
    - Participation in extra-curricular science-related cultural practices (activities and pastimes) (e.g. visiting science museums, zoos/aquaria; after-school science clubs; doing experiments/using science kits at home; fixing/building things at home; nature walks; programming computers)
- STEM-related social capital:
    - Knowing someone who works in a science-related job (parents, family members, neighbours, friends, etc.)
    - Parental science qualifications
    - Frequency and number of people who talk to about science (parents, teachers, family members, friends, extended family, scientists)
    - Social recognition of the self as 'scientific' and/or motivation from others to continue with science (e.g. "other people think of me as a science person"; "my teacher has specifically encouraged me to continue with science after GCSE")

Transforming this into a measurement instrument, this coalesces around nine resolvable components:

- Everyday science (media) engagement
- Future science job affinity (aspirations)
- 'Informal' science activities
- Parental attitudes and practices (including attitudes to science)
- Science teachers and lessons
- Self-efficacy in science
- Utility of science qualifications
- Valuing museums/museum experiences
- Valuing science and scientists

Calculating a science capital 'score'

Statistical analyses of the survey responses were conducted, from which we identified the strength of response to the following questions and statements as being the strongest predictor of whether a student would fall into the high or low grouping on the outcome variable (a set of items that group together into a variable that relates to the likelihood of a young person planning to continue with science post-16):

- A science qualification can help you get many different types of job
- When you are NOT in school, how often do you talk about science with other people and with whom?
- Who do you know who works in a job using science?
- One or both of my parents think science is very interesting
- One or both of my parents have explained to me that science is useful for my future
- I know how to use scientific evidence to make an argument
- When not in school, how often do you read books or magazines about science?
- When not in school, how often do you go to a science centre, science museum or planetarium?
- When not in school, how often do you visit a zoo or aquarium?
- How often do you go to after school science club?
- My teachers have specifically encouraged me to continue with science after GCSEs
- My teachers have explained to me science is useful for my future
- It is useful to know about science in my daily life

The methodology is described in more detail in the full paper.

About the partners

BP is the principal funder of the Enterprising Science programme. BP has been supporting the education of young people in the UK since 1968, helping to increase the numbers of young people choosing science and maths for their futures.

Enterprising Science is underpinned by research led by King's College London, building on the ASPIRES study of children's science and career aspirations. This expertise supports the development of effective, evidence-based tools and techniques that will bring science to life like never before for young people, their teachers and families, both inside and outside the classroom.

The programme builds on the success of the Science Museum and BP's previous five-year Talk Science project. The Science Museum Group are ideally placed to develop practical tools to increase levels of science capital through their reach with families, particularly those from lower socio-economic groups, in a distinctive way that complements rather than replicates the school environment. This includes enriching a young person's experience through encounters with scientists, objects and experiences beyond the curriculum; making abstract concepts concrete, meaningful and relevant to them as an individual.

For more information

Visit the King's College London pages for the Enterprising Science partnership at www.kcl.ac.uk/enterprisingscience, where we share the emerging findings from our research.

For more specific questions or to request a provisional copy of the paper prior to its publication, please use the Contact Us details on those pages.