

## Handle with care...

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I'm writing this after a fantastic village bonfire night with loads of colourful and explosive entertainment. It was certainly a big thumbs-down in terms of our carbon footprint – but it was fun. Being a STEM Special Edition, it seemed appropriate to write this piece in that context.

There are obvious advantages in building integrated activities across the curriculum not least because the world outside school does not operate in disciplinary packages. A performance in the national theatre or a bonfire night firework spectacular provide ample evidence of the richness that can result from the integration of arts and sciences. So how can it be anything other than good to build a systemic integration of a chunk of the curriculum; science, technology, engineering and maths?

Like so many government initiatives STEM originates in the USA. Over there it involved a collaboration of the National Science Foundation, the US Dept of Labor (forgive the transatlantic spelling), the National Academies and an extensive coalition of science-rich industries (like NASA). It was premised on 'workforce-needs'. The DCSF accepted the wisdom of this thrust and their pronouncements about STEM are pretty much indistinguishable from those in the USA.

The Government wants to increase students' STEM skills in order to:

- provide employers with the skills they need in their workforce;
- help to maintain the UK's global competitiveness;
- make the UK a world-leader in science-based research and development.

<http://www.dcsf.gov.uk/stem/> (downloaded 13/11/10)

Statements written at this global (political) level are bound to be a bit anodyne – but it seems to me that there is nothing wrong with having a curriculum that plays to the national need for employable young people. Unless of course the rationale gets out of control. The recent announcement of cuts in higher education is framed within the STEM agenda. If universities are offering STEM related programmes – they get a teaching grant. If not...they don't. This seems to me to be a wildly unbalanced policy – not least because the fastest growing industrial/commercial sector in Britain is the Creative Industries: film; advertising; radio; design; multi-media production and all the rest. None of this will receive support in terms of HE teaching grant despite being at the leading edge of worldwide performance, and despite being critical to the economy of the nation. To this extent the STEM agenda – perversely – has the effect of confounding its own claim to supporting UK global competitiveness. However, I guess the STEM folks would

argue that it is hardly their fault if government policy goes off on a wild frolic of its own.

So lets keep the focus more closely on what STEM is doing. I would draw readers' attention to an interesting report just published by the Centre for Education and Industry, University of Warwick, (2009). It has the intriguing title "Lengthening Ladders, Shortening Snakes" and is all about "embedding STEM careers awareness in secondary schools". On page 10 we get an interesting analysis of the contribution of the four titled curriculum areas. Specifically – concerning science – we are told that there is a problem of *authenticity*.

'Science is currently isolated from its real-life applications and pupils should, on occasion actually "make something", which would forge a natural connection with technology and engineering.'

This is a pretty scathing indictment of the science education community. It is publicly acknowledging that science teachers have (presumably for the decades that it has been a formal subject of study) consistently failed to generate a convincing pedagogy.

The 'engineering' bit of STEM suffers from a somewhat different problem...it doesn't really exist in UK schools. The label is a product of two unfortunate circumstances. It derives in part from STEM's USA heritage, and also (in part) from the downward transposition from HE. It exists in universities – so schools have to deal with the label. And yet – as the Warwick report makes clear...

'few young people know what 'engineering' means, ...it remains outside of mainstream study for most.'

Maths of course has yet another different problem. No-one likes it.

'How to counter the low popularity of mathematics by making it more interesting and relevant was an emerging theme...why does mathematics appear to be unpopular with many young people?'

Whilst science teaching is seen by the report as being remote from reality – maths teaching would appear to be so bad that it manages to turn-off large swathes of the school population.

I'll come in a moment to what the report says of 'technology' in STEM, but first I think it would be helpful if the whole STEM initiative started from the recognition that the lack of authenticity in science and the unpopularity of maths is a product of inadequate models of practice developed over decades in schools. Two factors seem to me to be complicit in this. First is the difficulty of balancing

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process and content. Science in particular has been bedeviled by wheel-barrow loads of content. The original version of NC science had (I think) 17 attainment targets – mostly different packages of content. That has since been rationalised back to (in effect) physics chemistry and biology + AT1 which is the process bit about scientific enquiry. But real scientific enquiry takes time – as do real design and technology projects. And as science teachers have to pack in all that stuff, where do they get the time for real enquiry? It might be instructive for readers to go and see what your science department is doing in this area. But second, there is the problem that arises from the fact that maths and science are high status knowledge domains. This status insulates them from the need to make themselves interesting and meaningful. It is enough to say 'we are maths'...'we are science'...and that's the end of it. If students fail (or refuse to show any interest) then it's clearly something lacking on their part.

So let's turn to what the report says about 'technology' in STEM. For a start we should be clear that technology really means DESIGN and technology, though STEM doesn't appear to like the *design* word. Anyhow, here we are told that there is much potential...

"...for technology education to draw out the applications of scientific and mathematical ideas...technology education should produce better links between skills, abilities and types of career and be the bridge between academic study and real life activity."

(all excerpts from the report are from p.10)

So here we have it. Science and maths have all that really important stuff that is either remote from reality or boring and our job in technology (I mean of course DESIGN and technology) is to make it all real and palatable.

Reading the report one could be forgiven for thinking that design and technology might be seen as the saviour of STEM. It really is the integrator, the sense-maker, the interest-provider that transforms arid and failed models of learning and brings them to life. We bring a strong tradition of project-based learning, enriched by our familiar traditions of tuning projects to the interests of individual learners. We bring *procedural* capability to the table – developing in learners the ability to identify real-world tasks, to tackle them effectively and to bring them to resolution in the made world. We have developed this pedagogy systematically and over decades – whilst science and maths appear to have been asleep on the job.

But hold on a minute...where are teachers required to go for the CPD to help develop their approaches to STEM? Its all conducted in Science Learning Centres. Of course it is – they have such a great track record!

Actually the Design and Technology Association is involved in these CPD courses. After years of development with Electronics in Schools, the Marconi project, the CAD/CAM initiative and lots more, the D&T Association has been involved in the development of a pair of really interesting one-day STEM courses for teachers: 'Lets make it work' and 'Lets make it move'. But – despite the fact that they are free to schools – there is real concern about the number of teachers being attracted to them – and probably because of their location in Science Learning Centres.

There is the potential in STEM to completely resurrect the pedagogic strength of science and maths; to so completely reconfigure them that their previous failings – identified so baldly in the Warwick report – can be set aside as we progress together into the sunlit uplands of learning.

I can imagine projects in which science, maths and DESIGN and technology collaborate really effectively and to the benefit of all concerned. Just like I can imagine such projects bringing together history, music and technology, or art, geography and technology. What makes such projects work is not a mission-statement of the USA National Science Foundation and Department of Labor (with or without NASA), but the creative relationships between the teachers that plan and operationalise the projects.

But my overriding thoughts about STEM are pretty well summarised by the message that was stenciled in big bold letters on the box of fireworks that I was opening the other night. In the best Health and Safety tradition the message was simple, and clear. 'HANDLE WITH CARE'.

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