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Design and Technology

Educational fallacy or principal exponent of school-based STEM activity?

Introduction

The hierarchal status of 'academic disciplines', what defines valuable or legitimate knowledge, and what should we teach our children? These are all topics of much debate (Gibb 2015, Morris 2012).

Set within the context of a flexible education system, that affords academies and free schools autonomy, and building on the premise that design and technology is an educational construct; a subject which outside of education does not exist, work presented here is derived from an initial review and study of literature, undertaken during the initial stages of a larger research project. The focus of the latter being investigations into the pedagogical convergences and divergences between Science, Technology, Engineering and Mathematics (STEM) as discrete disciplines cognisant of implications for teaching and learning.

At this stage preparatory work sought to establish the position of design and technology's role within STEM education, and to understand why as a STEM curriculum subject, design and technology is persistently marginalised (Green 2014).

Classification of Disciplines

	Hard		Soft	
	Life	Non-life	Life	Non-life
Pure	Biology, Biochemistry, Genetics, Physiology	Mathematics, Physics, Chemistry, Geology, Astronomy, Oceanography	Psychology, Sociology, Anthropology, Political Science, Area Study	Linguistics, Literature, Communications, Creative Writing, Economics, Philosophy, Archaeology, History, Geography
Applied	Agriculture, Psychiatry, Medicine, Pharmacy, Dentistry, Horticulture	Civil Engineering, Telecommunication Engineering, Mechanical Engineering, Chemical Engineering, Electrical Engineering, Computer Science	Recreation, Arts, Education, Nursing, Conservation, Counselling, HR Management	Finance, Accounting, Banking, Marketing, Journalism, Library And Archival Science, Law, Architecture, Interior Design, Crafts, Arts, Dance, Music

Adapted from Biglan's typology (1973a, b)

Utilising Biglan's typology (1973a,b) the classification and hierarchal status of individual STEM disciplines is explored. According to this theory, approaches differ significantly between categories; hard disciplines (maths and science) have more concern for knowledge application, focusing on facts and logic. Soft and applied disciplines (design and technology) tend to place emphasis on knowledge acquisition and they are concerned with innovation and creativity.

An overview of STEM, within the context of education

Originating as a government initiative STEM is an acronym describing the study of Science, Technology, Engineering, and Mathematics (STEM). Globally, STEM is perceived as vital in securing economic prosperity (Li 2014, Marginson et al. 2013, Obama 2013a, Katsomitros 2013, Roberts 2002).For over a decade, STEM has been the focus of discourse driven by changing global economies in a post-industrial era. Anxiety around the disconnect between those intending to pursue STEM careers, and those who demonstrate ability in STEM based disciplines (Heitin 2014) has further fuelled concerns over a predicated labour shortage (Ritz and Fan 2014; Kennedy and Odell 2014). To ensure a highly qualified STEM based workforce, governments have adopted a functionalist approach to policy (Obama 2013b, Bassett et al. 2010, Kuenzi 2008). In England and Wales visible manifestation of STEM policy can be evidenced via increases in bursary funding for those embarking upon STEM Initial Teacher Training (ITT).

There remains variance within different STEM disciplines - those seeking to pursue careers in mathematics, physics, chemistry, and computing, are eligible for a bursary up to £25,000 (DfE 2015a). Support for those training to teach engineering, or design and technology is less lucrative, engineering attracts no bursary support, whilst design and technology trainees may be eligible for one up to £12,000. Understandably this financial inequity has potential recruitment consequences.

The origin of design and technology

Prior to 1988 design and technology existed as a series of individual disciplines. One could argue in creating a single subject the government sought to combine practical and vocational disciplines in order to reduce costs, whilst increasing both curriculum time and space for more academic subjects. In the original orders, design and technology was created as a subject;

'…always involving science or mathematics."

(Department for Education and Schools 1988)

Therefore, from a juxtaposition, one could reason that without mathematics and science, design and technology would not exist. From this perspective, it could be argued that design and technology was constructed by a forward thinking government, seeking to establish a vehicle through which science and mathematics could investigate the practical application of principles and theories, empowering pupils to contextualise facts and theories in their application. By doing so; creating an environment where children would become technologically and STEM literate, long before STEM became an entity. However, if this is the case, then why it is design and technology's potential to contribute constantly overlooked?

Design and technology: a legitimate STEM discipline?

Since design and technology's inception, it has been marginalised from STEM education policy (Morgan 2014), which frequently focuses only upon mathematics and science. Analysis of the current design and technology curriculum (DfE 2013) illuminates a positional shift, with the instruction to '*draw on disciplines*' rather than to work with them. Following analysis of individual curricula for mathematics, science and computing there instruction appears unique. This positions design and technology uncomfortably as a subject different to its peers, seemingly without its own discreet set of knowledge and skills, which one could argue lowers its standing as a discipline in its own right.

A review of literature

Citing the difficulty of delivering non-linear, creative processes within a content and assessment focussed curriculum, and the struggle to balance new content with pre-existing practice, in his controversial review Miller (2011), provides a piercing account of 'what' is wrong with design and technology, but his work stops short of offering an explanation that supports our understanding as to 'why' this may, or may not, be the case.

In seeking to answer the research question, a preliminary review of the literature relating to disciplinary knowledge (Neumann et al. 2002, Becher and Trowler 2001, Becher 1994), teaching and learning regimes (Trowler and Cooper 2002), and what constitutes subject knowledge (Maton 2013, Maton and Moore 2010) has been undertaken.

"Why would you do a hard subject like maths or science or a language when you could do an easier subject?"

(Coe 2010).

Amidst concerns of academic declines, tackling the 'culture of low expectation' and 'anti-intellectualism', Gibb (2015) is scathing of the disproportionately low number of pupils from disadvantaged backgrounds being entered for academic subjects. Whilst acknowledging that vocational and technical disciplines are vital to future economic growth, he believes that only by placing academic subjects at the heart of the curriculum can we ensure a rigorous education for all. Since the introduction of performance league tables, schools have sought to deliver qualifications that afford them the most favourable results. The strategy created to stem this was the introduction of the Ebacc and Progress 8 (DfE 2015), the measure by which pupil performance is calculated.

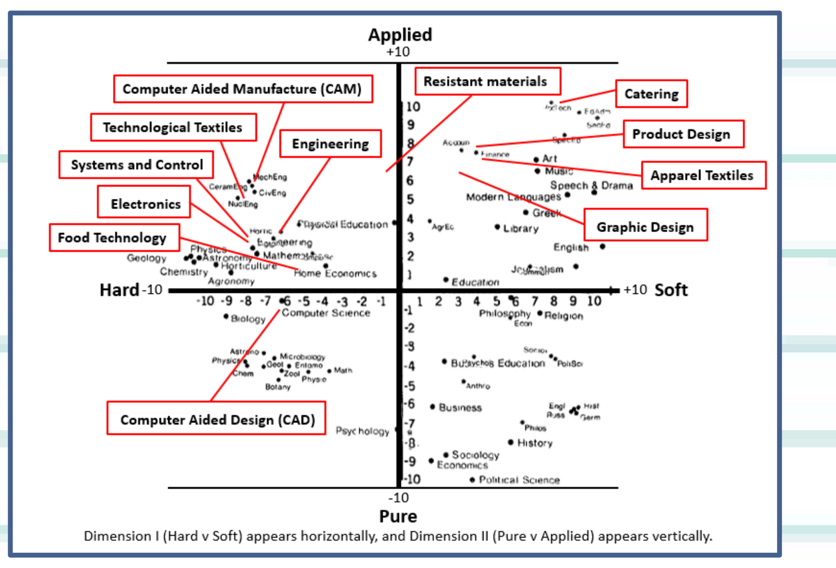
Bernstein (1971a,b, 2000,) explores social class, performance at school and how education reproduces inequality, seeking to distinguish between school and everyday knowledge. He contended that how a subject is taught either enables or prevents access, classifying and framing, knowledge hierarchically. To support the distinction between different types of curriculum, and illustrate the power relationships between what is taught, and how knowledge is learnt, Bernstein (1971a,b) developed coding theory. Science and mathematics align with the curriculum code; both classification and framing is strong, the teacher has control, content is pre-determined, and framed explicitly within clear boundaries (Mclean et al. 2013). Aligning with design and technology the integration code; classification is weak, subject boundaries are blurred. Where framing is also weak, the pedagogical approach may be determined between student and teacher.

Bernstein maintained that the status of subjects in the school curriculum is derived from well defined, classified bodies of knowledge which remain consistent over time. Design and technology's characteristics are distinctly different to mathematics and science, it is unsurprising that comparatively, design and technology finds itself disadvantaged.

Theoretical application

In direct contrast to science and mathematics, which are classified as hard, pure disciplines with strong external boundaries, literary theory (Bernstein 2000, 1971a, 1971b, Biglan 1973a,1973b, Becher 1994) classifies design and technology as a soft, applied subject with weak external boundaries, which are difficult to define.

This fluidity manifests instability and leads design and technology to become a subject easily misunderstood, particularly by those working outside of it. Design and technology is both complex and difficult:



Design and technology's position within knowledge territories

Model adapted from Biglan (1971a,b)

Knowledge should flow like money, to wherever it can create advantage or profit. Indeed knowledge is not like money, it is money

Bernstein 2000:86

The question this study seeks to explore is: Why is design and technology perceived to be of less value [importance or worth] than its STEM counterparts?

Conclusion and next steps…

Prior to its creation, design and technology comprised of individual disciplines, each with their own body of knowledge. Through amalgamation each has been diluted, with individual subject identities stripped away.

Within a curriculum that places value predominantly upon disciplines perceived to be academic, 'skill' is not seen as desirable. In seeking to justify its place within the curriculum, design and technology has sought to establish values and core knowledge that align with academic rather than vocational characteristics. The breadth of design and technology curriculum is unwieldy and expansive, an issue amplified by the ever changing nature of technology itself. If it ever had one, design and technology has lost its boundaries and its identity.

Fluid in curriculum content, coupled with nomadic characteristics; design and technology finds itself in an uncomfortable, and isolated place. Whilst the theories embedded in literature prove useful in aiding our understanding as to why design and technology is perceived as being of less value than its STEM counterparts, redressing this perception is challenging.

Rooted in an accessible pedagogy, design and technology is at odds with its STEM counterparts, and as such may afford pupils a different way to access the STEM curriculum, one that would support the equitable access, for all learners. It is this potential that subsequent research phases will explore.

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