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# Humanising the design and technology curriculum: why technology education makes us human

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## Introduction

Design and technology (D&T) emerged from a very different education context than it finds itself in today. D&T was to be included in the National Curriculum for England because it was perceived that what children learnt from design and technological activity could not be learnt in another way (DES/WO, 1988). Furthermore, it connected a wide range of subjects across the curriculum, developing capability "to operate effectively and creatively in the made world" (p.3). Henceforth, the role of knowledge for action in D&T, primarily through designing and making, has been viewed as a great strength and unique feature in the subject (cf. Black & Harrison, 1985; Kimbell, 2018; Kimbell, Green, & Stables, 1996; McCormick, 1997; Morrison-Love, 2017).

D&T emerged into the curriculum, in England, from craft education roots (Allsop & Woolnough, 1990) to its more modern, design oriented, iteration (Atkinson, 1990). It has been a somewhat challenging journey from the outset, with calls for agreement on its purpose, nature and value in the curriculum (Wright, 2008). However, in the face of a paradigm shift, from the teaching of individual material-oriented and traditionally gendered subjects (home economics and craft design and technology) to a unified design-oriented curriculum, many teachers retreated into familiar territory (McLain, 2012; Paechter, 1995) – i.e. craft and material based skills and practice. The focus on capability under the multidisciplinary umbrella of D&T, whilst compelling within the D&T education community, has arguably failed to win the hearts and minds of many. Indeed, the relative lack of the subject's own body of propositional knowledge has recently led to criticism under the influence of a so-called knowledge rich curricular ideology (DfE, 2011, 2016; Gibb, 2017). D&T has also been criticised for failing to live up to its early expectations in many schools, struggling with the constraints of a content focused curriculum and assessment (McGimpsey, 2011; Miller, 2011) and a lack of "funded and systematic research" (Harris & Wilson, 2003, p. 62).

The aim of this paper is to reposition and reinvigorate how D&T is interpreted and enacted within the school curriculum. Not merely as an industrial imperative, with its focus on technical and economic matters, but on D&T as a cultural, creative and humanising endeavour. Our argument is that technological activity is fundamentally human and integral to our evolution and development as cognisant and social beings. Therefore, to measure a subject by it's so called timeless knowledge in opposition to skill (Gibb, 2016) falls short of achieving a broad and balanced curriculum (Spielman, 2018); in particular a relatively new and evolving subject encompassing the complexity of technology and society, with their complex and changing natures. However, there may be light at the end of the tunnel, with inspection findings of "evidence of curriculum narrowing" in England and the negative impact of focusing on "few measurable outcomes" (Ofsted, 2019, p. 5); which may result in a resurgence of opportunities for pupils to study practical and creative subjects, such as D&T, in opposition to the perverse incentives that have led to said narrowing in school curricula.

## Theoretical Framework

Curriculum can be viewed and understood through different theoretical lenses, each with their own drivers, such as aims (Reiss & White, 2013), knowledge (Young, 2008) and experience (Biesta, 2014). In these politically turbulent times for D&T in England, we adopt a pragmatic stance (Biesta, 2014; Biesta & Burbules, 2003; Dewey, 1966, 1944, 1916) side stepping the whole knowledge verses skills debate and focusing on experience and the interaction between mind and hand (Kimbell et al., 1996). We do not argue for a new curricular hegemony, dethroning knowledge and reinstating skill, but a more nuanced and accommodating political climate with regard to curriculum and pedagogy – both the 'Big P' of national and the 'small p' of local policy and practice.

***Figure 1. Evidence of technology in the natural landscape (McLain, 2018)***

With regard to technology, we consider it as inextricably linked with society and social activity, evident within even the most natural seeming historic landscapes Figure 1 the marks of land management (dry stone walls) and urban infrastructure (reservoir); not to mention paths and other signs of human action and interaction with our environment endure. Rather like a Mobius strip, Figure 2 with its surfaces intertwined in a dynamic interaction, as a visual metaphor for socio-technological human activity. Denying absolute or dualistic interpretation of the world (Russell, 1993), in the traditions of pragmatism, technology and society are viewed holistically as part of a "technical-social way of life" (Bruner, 2009, p. 160).

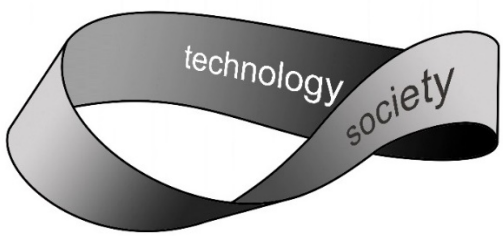


***Figure 2. Mobius representation of technology and society (McLain, Irving-Bell, Wooff, & Morrison-Love, 2018, 2019)***

As indicated above there are several challenges facing D&T, as a curricular entity, namely its unique body of knowledge and the multiplicity of meanings of technology. With the aim of exploring D&T experience at the present time, some problem finding (Chand & Runco, 1993) may help bring into focus some of the unspoken complexities or assumed shared understanding around knowledge and technology. To this end we will briefly explore Mitcham's modes of the manifestation of technology (Mitcham, 1994) and Bernstein's classification and framing (Bernstein, 1971).

## The problem with D&T

The current United Kingdom government began its educational policy reform with an expert panel report concluding that some subjects, D&T, information and communication technology (ICT) and citizenship, had insufficient "disciplinary coherence" (DfE, 2011, p. 24) compared to other subjects. As a result, computing (computer science) rose, like a phoenix, from the ashes of ICT and both D&T and citizenship were proposed to be reclassified. The footnote for this judgement justified the panel's stance as taking "a view of disciplinary knowledge as a distinct way of investigating, knowing and making sense with particular foci, procedures and theories, reflecting both cumulative understanding and powerful ways of engaging with the future"(p. 24). This is a dense phrase, so let us pick at the thread in an attempt to understand. Firstly, the authors did not appear to believe that D&T had distinct disciplinary knowledge. Second, that they did not believe that D&T had a distinct disciplinary approach; pedagogy, if you will.

Viewed as an educational construct (Bell, Wooff, McLain, & Morrison-Love, 2017) D&T lacks a distinct body of knowledge when its component parts are analysed (Figure 3). Bell et al. (2017) examined common disciplinary areas in the subject as hard/soft and applied/pure. Perhaps not unexpected, the knowledge 'territories' occupied the applied side of the curriculum, but tensions between so called *hard* and *soft* knowledge were evident. This tension is evident within individual disciplinary areas, such as textiles, where 'technological' textiles and 'apparel' textiles are located in opposing quadrants in the hard/soft continuum. So-called *hard* subjects being more concerned with adherence to a relatively definable body of knowledge (didactics), and *soft* to the process of acquiring and creating knowledge (pedagogics). This fluidity, combined with the shifting nature of technology and society, makes D&T difficult to define and contain. What could be viewed as a strength, i.e. the ability of a subject to evolve over time to equip children and young people for life in an evolving society, becomes an impediment where knowledge is required to be organised and timeless.

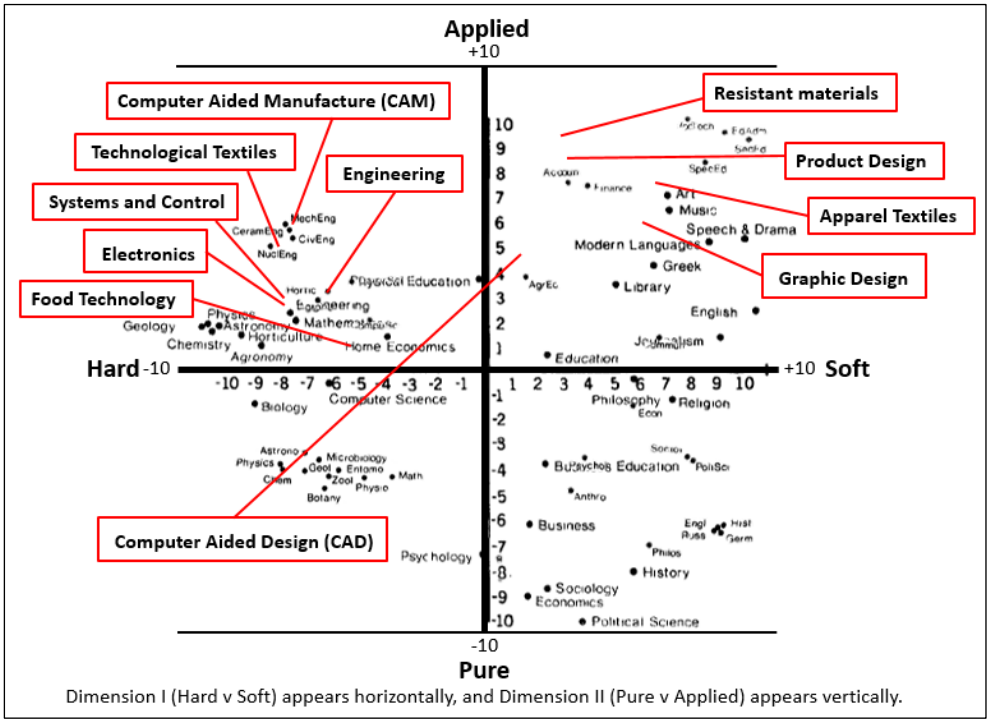


***Figure 3. Knowledge territories within design and technology (Bell, 2015; Bell et al., 2017)***

At this point the typical D&T educator waves their hands in the air and says, "but hold on…!", little realising that there is possibly an unspoken bias or agenda. However, the expert panel's repeated choice of "powerful" and "powerful knowledge" on six occasions (2011) indicated a bias towards Young's analysis of knowledge and power (Muller & Young, 2019; Young, 1971, 2008), where certain specialised, context-independent knowledge is considered valuable on the grounds that it provides the basis for making generalisations and claims. This perspective considers the aforementioned kinds of knowledge to be more important, or valued, than 'mere' procedural and context-dependent knowledge that add depth and breadth to D&T and other practical and creative subjects. Similarly, the term 'cumulative' implies a hierarchical knowledge structure, where one concept builds on

another, which is not the case for all subjects; some of whom have a more 'segmented' or horizontal (non-hierarchical) knowledge structure, where there is no predetermined or ideal sequence of learning (Maton, 2009). Both cumulative and segmented learning have their merits and problems, and the strength of the later (of which much encompasses D&T learning) is contextualised learning, which is also criticised for potentially inhibiting transfer and generalisation of knowledge.

The panel go on to give this trio of 'could do better' subjects (D&T, ICT and citizenship) a somewhat backhanded compliment about the worthwhile nature of such applied learning, albeit with "weaker epistemological roots". Therefore, we might ask how we find ourselves in this conundrum and whether it is a surprise, given the nature of D&T disciplines and their associated knowledge. We contend that, in some subjects and in a "technologically advanced society" (Ofsted, 2011, p. 4), change might be viewed as a good thing. Similarly, the somewhat segmented nature of some D&T learning, which extends into a range of knowledge associated with other disciplines, and focuses on designing and making in a variety of contexts, should be view as an essential part of the subject's *raison d'être*, rather than a 'weakness'. For example, the purpose of study statement, in the National Curriculum programme of study (DfE, 2013, p. 234), states:

> "…Using creativity and imagination, pupils design and make products that *solve real and relevant problems within a variety of contexts, considering their own and others' needs, wants and values***.** They *acquire a broad range of subject knowledge* and *draw on disciplines such as mathematics, science, engineering, computing and art*... Through the evaluation of past and present design and technology, *they develop a critical understanding of its impact on daily life and the wider world*. High-quality design and technology education makes an essential contribution to the *creativity, culture, wealth and well-being of the nation*." [*emphasis ours*]

From the earliest times in human history, we have used tools to shape our physical and social environment. It has been suggested that Homo Sapiens (the wise or thinking man) could have easily have been Homo Faber (the working or making man). Arendt placed the notion of human activity firmly with in the social ("world of men") and the technological ("man-made things") environment (1998, p. 22). This is the world into which we are born and together, inseparable, "form the environment for each of man's [sic] activities" (p. 22). Arendt traces a contempt for labour rooted in the origins of western thought, which continues to this day, fossilised in Aristotle's classification of Epistēmē (scientific knowledge) and Technē (craft knowledge) (Scharff & Dusek, 2003), with the latter being somewhat undervalued and understudied, in a systematic way (Hickman, 2001). This, despite emerging evidence from modern science as to the importance of technology and tool use in human evolution and cultural development, including the heuristic approaches to problem solving leading to causal beliefs (McCormack, Hoerl, & Butterfill, 2011; Wolpert, 2003) or language (Campbell, 2011; Greenfield, 1991).

Therefore, technology sits in relative epistemic obscurity, compounded by a plethora of definitions and perspectives which Mitcham attempted to draw together into a "set of quasi-empirical categories" (1994, p. 269). Mitcham noted the tensions between the scientific abstraction and technological application of knowledge, identifying four modes

(categories) in which technology manifests itself in society: technology as object, as knowledge, as activity and as volition (Figure 4).

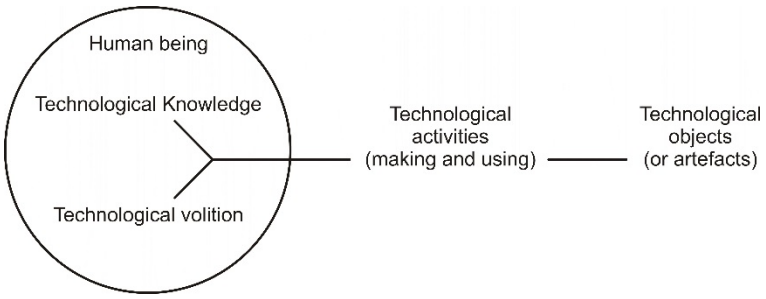


***Figure 4. Mitcham's Modes of the manifestation of technology (Mitcham, 1994, p. 160)***

Mitcham further classifies technological knowledge and volition as being concerned with human 'being', with making and using of technology being external activities resulting in technological objects, which in D&T would be referred to as products or prototypes. The link between the *object* and activity modes are familiar features of the D&T curriculum, with a focus on designing, making and evaluating prototypes (e.g. products or systems). As stated above, knowledge becomes problematic in the current political climate. However, Mitcham defines technological knowledge with taxonomy developing from heuristic approaches of mimicry and trial and error (sensorimotor skills), to rules of thumb (technical maxims), recognised causal effects (descriptive laws) and real world application of theory (technological theories). Technological theories begin to develop cumulative (hierarchical) knowledge, and are part of D&T. For example, the "functions of mechanical devices" or "categorisation of the types and properties of… materials" (DfE, 2015, p. 6) . However, this is alongside the more heuristic aspects requiring an understanding "that all design and technological practice takes place within contexts" and of "client and user needs" when designing and developing ideas (p. 7). Considered through Mitcham's mode of technological knowledge, the D&T curriculum includes a rich variety of learning across the spectrum. The fourth mode, volition, describes the human drive for control and freedom, which affects human beings' thinking, values and motivation. In this mode, Mitcham emphasises technology's role in the practical and incremental developments "embodied in culture and perpetrated by tradition" (Mitcham, 1994, pp. 36-37). This technological volition is a fundamental human drive, compelling activity and objects with evolving knowledge from prehistoric times. Rather than technology being viewed as a hard or rigid field, in the context of D&T we propose that it humanises the curriculum; recognising the cultural importance not just of what 'we' produce, but how and why we do so.

Having focused on the wider understandings of technology in society, the notion of the 'subject' or discipline in education provides a further insight into the problem of D&T. Bernstein, in an attempt to understand why lower socioeconomic status children do less well in school, analysed language to distinguish between school (elaborate) and everyday (restricted) language in order to understand how children learn (Bernstein, 1990). He concluded that children's understanding of the language used in school subjects may either

enable or inhibit their access, and thus their ability to articulate their thoughts. This poses a two-fold problem to a subject like D&T, the first of which being the aforementioned complexity and ambiguity of technology in society and the second the technical nature of the language often employed.

Furthermore, Bernstein (1971) *classified* subjects according to the relationships between what knowledge is taught by different subjects (curriculum), and *framed* by how subjects are learnt (pedagogy). This classification and framing of subjects led to the identification of so-called boundaries between subjects, where subjects with unique and definable knowledge where classified as 'strong'. In contrast, subjects that share knowledge or adopted thematic approaches to teaching were classified as 'weak'. In the National Curriculum, D&T has been presented as drawing on knowledge from other subjects (DfE, 2013, 2015); a feature that when viewed through Bernstein's classification and framing, and a focus on powerful knowledge (Young, 2008), appears to undermine its purpose in the curriculum. As discussed above, D&T knowledge does not reside comfortably in a single domain (Figure 3) and leads to perceptions that it lacks a solid knowledge base; cementing the argument that, the knowledge base for D&T is 'weak', which under the lens of this analysis appears as an amalgam of so-called 'hard' (hierarchical) and 'soft' (segmented) learning.

Therefore, knowledge seems to be at the heart of the problem with D&T; or perhaps more accurately the current interpretation of knowledge by the policymakers in England at this point in time is a problem for the D&T community to address. We suggest that the answer is not a list of declarative or propositional knowledge, as important as these are, but a meaningful debate with policymakers about the nature of curriculum and the value of different kinds of learning – and thus knowledge. We return to a broad and balanced curriculum, not being bound by an ideological interpretation of knowledge, but recognising complexity and the multiple realities of human beings' experiences of technology and society.

## A solution for D&T

Mitcham's perspective on technology illustrated the complexity and multi facets that affect how society understands the term; and prompts us to be clear about whether a D&T curriculum should be dominated by knowledge, objects, activity or volition. As we have seen from Bernstein's classification and framing, knowledge it somewhat problematic for subjects that draw in other disciplines, or where knowledge evolves over time. Also, an over emphasis on technological objects, such as prototypes that pupils design and make (important as these are) may be somewhat limiting. A reframing of the argument for D&T should acknowledge the importance of technological activity (including problem solving and design thinking) and volition in human development. In other words, D&T has a potentially humanising role to play in the curriculum, at odds with the oft-bleak portrayal of technology through dystopian or deterministic lenses.

> "When education, under the influence of a scholastic conception of knowledge which ignores everything but scientifically formulated facts and truths, fails to recognize that primary or initial subject matter always exists as matter of an active doing, involving the

> use of the body and the handling of material, the subject matter of instruction is isolated from the needs and purposes of the learner, and so becomes just a something to be memorized and reproduced upon demand. Recognition of the natural course of development, on the contrary, always sets out with situations which involve learning by doing." (Dewey, 1966, 1944, 1916, p. 217)

A pragmatic view of education (Biesta, 2014; Biesta & Burbules, 2003; Dewey, 1966, 1944, 1916) eschews the pendulum swing from knowledge to skills (e.g. Gibb, 2017), and vice versa. Pragmatists, such as Dewey, challenge the learning of facts that is devoid of application, favouring approaches to curriculum and pedagogy that accommodate knowledge 'and' skill, rather than privileging one over the other. In the above quote from Dewey's seminal work on democracy and education, the somewhat convoluted message is to broaden our notion of knowing to include "active doing"; to balance knowing that (conceptual knowledge) with knowing how (procedural knowledge) (McCormick, 1997; Ryle, 2000, 1990, 1963, 1949). From a pragmatic perspective, the problem of knowledge in D&T retreats, like an optical illusion rotating to reveal a hidden image. We return to D&T capability (Black & Harrison, 1985) and the interaction between mind and hand (Kimbell et al., 1996). So a solution may be to think differently, more pragmatically, about the design and technology curriculum.

In order to do this, we must first and foremost understand the underlying assumptions underpinning educational reform. In the current situation, knowledge is in the ascendency over skill, in the mind of the politician (embodied in the secretary of state for schools). The pragmatic side step is to avoid the difficult to define knowledge and focus on experience, but that will not quite do when programmes of study focus on timeless concepts. So the question focuses on the nature of knowledge in D&T and to what extent it is different or unique (strong). As we have discussed, much 'uniquely' D&T knowledge is contextual and by its very nature might be labelled as 'weak' or segmented, and this is fundamental to the intentions for the subject from its origins (DES/WO, 1988) to the present day (DfE, 2013, 2015). Therefore, to constrain the D&T curriculum to a framework informed by so called knowledge rich or knowledge led philosophies (Gibb, 2016, 2017; Young, 1971, 2008) is likely to be an ultimately futile activity with the subject being forever classified as 'weak' (Bell et al., 2017; Bernstein, 1971; McLain et al., 2018).

We propose a reframing of the discussion of knowledge in D&T, and beyond, to pragmatically focus on the curriculum as experience (Biesta, 2014; Biesta & Burbules, 2003) and remove the artificial distinction between knowledge and skill. It should instead, focus on and value both knowing that something is the case (conceptual) and knowing how to do or act (procedural) (Ryle, 2000, 1990, 1963, 1949). Conceptual and procedural knowledge in a symbiotic, non-dualistic, relationship with thinking (head) and action (hand) working together – knowledge for action (Kimbell, 2018; Kimbell et al., 1996) with 'transformation' - of resources into objects to shape our environment - at the heart of our pedagogy and curriculum (Morrison-Love, 2017).

## Conclusions

We contend that D&T is culturally important, as technological knowledge, volition, activity and objects play a central role in human and societal development. In a changing technological landscape, surely a technological curriculum must also be free from constrain, allowed to change – to evolve – without a requirement to align with certain ideological theories. The prevailing views on knowledge and curriculum amongst policy makers present an apparently impenetrable and unmoveable hegemony (as narrated in relation to recent education policy in England), which fails to recognise the complexity of 'technology' and expects all subjects to define themselves by a body of universal and timeless concepts. We say this is simply not good enough for our children who deserve a broad, balanced and rich curriculum, rather than narrowing choice. We call for policy makers to listen to and understand subject communicates and refrain from imposing unsuitable and ideologically influenced frameworks - one-size-fits-all is not fit for purpose.

We encourage D&T educators (teachers, teacher educators, leaders and researchers alike) to engage with the debate on knowledge, curriculum and pedagogy and to be aware of and to understand the implications and impact of political and philosophical ideologies on educational reforms, including how these are enacted in the school curriculum. It is particularly important for D&T teachers and the wider community to understand the nature and role of knowledge in the subject. An agenda for D&T stakeholders, curriculum designers and educational researchers should promote D&T as fundamentally human and humanising experience, with a cultural role to play where knowledge for action is central, in context and with a purpose.

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