Adapting the Design and Technology Curriculum: A Framework for Evaluation and Evolution

INTRODUCTION

The design and technology curriculum is not nor should be static. The professional and research aspects of design and technology create new knowledge. The nature of design and technology is that it evolves, the subject content itself grows. For example, as new technological processes and products and artefacts are developed (like artificial intelligence and autonomous vehicles) educators question whether and how they should be taught in schools. External political pressures also influence the subject's curriculum content. For example, STEM and STEAM came from political and economic ideas and challenges, that education was then expected to help address through changes to curriculum content and design. Although these agendas can have some positive contribution, primarily through funding and status (e.g. TVEI in the UK, the Perkins Act in America and Taiwan's focus on technology as a superpower), ultimately, they can lead to a lack of clarity about the nature of the subject. This leads to educators asking, debating or insisting that this new knowledge should be taught in schools. My view is when this happens it highlights a lack of consensus, dialogue and sensemaking for the subject and consequently, the planned curriculum is at risk of being overloaded with content. I liken the current style of curriculum evolution to the method described by the fictional Professor Peddiwell in *The Saber-Tooth Curriculum* (Benjamin 2004). Peddiwell recounts to Benjamin a curious tale about how the creation of a palaeolithic curriculum led to debate and tensions about the content. In England the design and technology content for one exam runs to over 60 pages, I think because we do not talk about what should be excluded as well as included

In this chapter, rather than reimagining a new curriculum, I present an approach for evaluating proposed new content or direction for design and technology. Following this proposed approach would lead to an agreed recommendation for the new content or direction to be added to the curriculum, or rejected. Rather than viewing any changes to the curriculum as an endpoint, I think we should see each development as a resolution. Each curriculum development and iteration viewed as a design resolution, answering: what is relevant and appropriate for the design and technology curriculum now?

As with development of a product, the curriculum needs to adapt, reduce, and maybe reject some longstanding feature. The alternative is an awkward addition, a part that might not fit, potentially making historic content 'grates' or sit uncomfortably in the new resolution, when really it should have been removed.

The approach involves two parts. First, who makes the decision and how. Second, I propose seven criteria for evaluating changes to the curriculum content. I end with a brief case study demonstrating how the criteria might apply to some content design and technology educators and researchers are currently testing.

COMMUNITY DECISION

Who decides?

In the land of the saber-tooth tiger (Benjamin 2004), two groups tried to influence the curriculum – the "thoughtfuls" and the "radicals", but only one group controlled the school – the wise old men. When D&T was first mooted as a national curriculum subject, a forum (officially a "Working Party") was created to propose it's the content, purpose and aims (Department for Education and Science and the Welsh Office 1988). McCormick's (1990) analysis of the group shows that members were design education advisors and consultants, education officers chief executive officers from non-government organisations and industry, a computer science university lecturer, and a professor of science education, plus two design and technology school department leaders.

Totalling thirteen with a chair, the group compromised eleven men and three women. Through their membership, each had a stake in the development of D&T, but McCormick's analysis shows that there was an imbalance in the expertise and legitimacy of the group, plus he seems to ask – did the group have salience? In other words, were they important to or connected with the development of a D&T curriculum? Williams (2007) explores this when he uses Mitchell, Agle and Wood's (1997) typology of stakeholders to analyse the attributes different stakeholders have in relation to a given D&T curriculum situation, such as implementing a new curriculum. I have developed the use of Mitchell, Agle and Wood's typology in my research on the value of design and technology, investigating the changing salience and values of stakeholders at different levels of curriculum influence and implementation (Hardy 2017 unpublished thesis).

Modifying Mitchell, Agle and Wood's (1997) business-focused definitions with a D&T focus the three attributes are defined as:

- Power: A stakeholder 'has power to the extent it has or can gain access to coercive, utilitarian, or normative means, to impose its will' (p.865) on D&T's nature, content or status.
- Legitimacy: a stakeholder exhibits their legitimacy through their desirable, proper or appropriate actions towards D&T. Their actions are deemed to be legitimate because they are constructed within a system of socially accepted norms, values and beliefs (Suchman (1995) in Mitchell, Agle and Wood (1997)).
- Urgency: 'the degree to which a stakeholder's claims [on D&T] calls for immediate attention' (ibid, p.867). Urgency is a dynamic attribute that 'exists when two conditions are met: when a relationship or claim is of a time-sensitive nature and when that relationship or claim is important or critical to the stakeholder' (Mitchell, Agle and wood, p.867).

Mitchell, Agle and Wood identified seven classes of stakeholders each with a descriptive name and description argues that each class has low, moderate or high salience defined as latent, expectant and definitive (Figure 1). Classes 1, 2 and 3 are *latent* stakeholders with only one attribute. Classes 4, 5 and 6 are *expectant* stakeholders with two attributes. The *definitive* classification (7) is the only group to have all three attributes and therefore the highest salience, that is they have the most prominence and are the most notable. Those possessing none of the attributes are non-stakeholders, or 'potential stakeholders' (Mitchell, Agle and Wood 1997, p.873). However, this model is dynamic and stakeholders from other groups can acquire other attributes by a change of situation or circumstance, such as coalition building or broadening the urgency to include other stakeholders (see Williams 2007 for examples). But I think Mitchell, Agle and Wood's theory does not sufficiently explore the dynamic influence of the 'levels of these attributes' on stakeholder's salience. What I mean is, although Mitchell, Agle and Wood exemplify how a stakeholder can acquire attributes and therefore move between the seven classes they do not consider whether a stakeholder has more than one position in relation to the business, or if there are different levels within each class of stakeholder, such as national or local level. My view is that these different positions and levels are also dynamic, so using three of Van den Akker's (2003) four levels of curriculum, the committee's membership also needs to include stakeholders from each of the following levels:

- system/ society/ nation/ state (or macro).
- school/ institution (or meso).
- classroom (or micro).

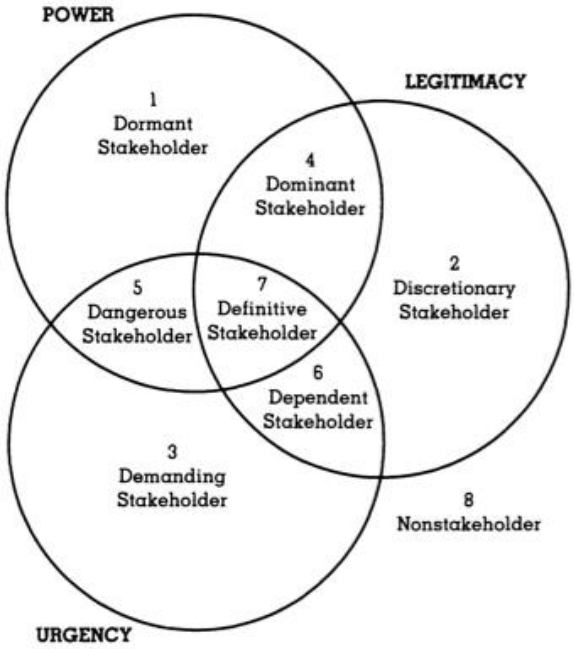

Figure 1 Stakeholder Typology (Mitchell, Agle and Wood 1997, p. 874)

Using this typology as a way of forming the "committee", I suggest focussing on the attributes of the members is more useful than on the who. Consequently, the group's attributes and salience would be consistent even when members left because their replacement's attributes would be the focus rather than their personality.

I suggest the committee includes members from these ten groups.

1. Curriculum policy writers because they know the policy and its interpretation.
2. Design and/or technology professionals who create new knowledge and they will employ or train young people who come through with this new, or dysfunctional, knowledge.
3. D&T teacher educators and researchers ("D&T academics") who expertise in D&T pedagogy and educational settings.
4. Ethical advisor who would ensurethe panel and curriculum had integrity, transparency, and a commitment to promoting ethical education practices education. The assumption too often is that the purpose of education is to feed a nation's economy; this member would be there, in part, to counter this viewpoint.
5. Exam boards who manage external qualifications.
6. Higher education (HE) design academics who work in one of the many fields involving design (e.g product, fashion, architecture) and, like the design and/or technology professionals, create the new knowledge and require qualified applicants for their courses.
7. Primary and secondary school D&T teachers as they know the limitations and potentials of curriculum changes.
8. School inspectorate representative: In England this would be Ofsted.
9. School leaders who allocate resources to the subject.
10. Special Interest Groups (SIGs) organisations, such as subject associations and others that might create professional development who work with individual teachers and national influencers. These groups have a legitimate and, at times, urgent interest in D&T.

Table 1 Categorisation of each stakeholder at each level using the typology from figure 1

Stakeholder	***Macro***	***Meso***	***Micro***
Curriculum policy writers	7	1	8
Design and/or technology professionals	2	8	6

D&T academics	2	8	6
Ethical advisor	2	2	2
Exam boards	6	8	3
Higher education design academics	2	8	6
Primary and secondary school D&T teachers	6	6	7
School inspectorate	8	3	4
School leaders	8	7	1
Special Interest Groups (SIGs)	6	3	6

This categorisation will cause some debate amongst readers; I do not expect agreement with my placement of the stakeholders, and some of the stakeholders' position is fluid and their influence could change if they pair up with another stakeholder group (Williams 2007).

How will they decide?

The group needs to talk but it is how they talk that is crucial. One approach would be for a democracy, where the members vote and if the new content has more "yes" than "no" then it's in. But this breeds discontent and disharmony. Instead, I propose the group engage in a dialogue to make sense of how the proposed curriculum change could work or not. For this I am drawing on the work of Bushe and Marshak's (2015) dialogic organisational development. This means the group focus on the ideas and variation in opinion about the content rather than on the people. To do this, individuals come with a dialogic mindset that involves accepting that the group is making meaning of the proposed changes, the decision emerges from the group's dialogue and is negotiated (Bushe and Marshak 2015).

By taking a dialogic approach the implicit idea is that the curriculum development is about continual development, not a start and end point. The group realise there will not be a perfect curriculum. Instead they see the curriculum as evolving, talking about how it can be improved, whether and which issues outside the subject should affect it. Therefore, the group would need to talk on a regular basis.

With each proposed change the group needs to have unanimous agreement before moving on. Initially this would be a time-consuming process but with familiarisation of the process and criteria this would change. What would emerge from the dialogue would be stories that create a space for a shared culture. Differing opinion within the group would be seen as positive and part of the wider puzzle, meaning everyone would gain a more rounded deeper understanding of the issue.

In the next section I propose seven criteria the group could use for making meaning of any proposed changes to the design and technology curriculum. The group's first step needs to be talking and agreeing on the criteria

THE CRITERIA

Each proposal for new content would need evaluating against a set of criteria. Some criteria may be more relevant than others to different proposed content [wc]. The criteria are a guide for the panel to evaluate the proposed new content, not a straitjacket that each proposal should meet the criteria. It is about an awareness of what adding new content might mean to the curriculum and the nature of the subject.

Hornbake (in Benjamin 2004, p.xi) poses four questions which form the basis for these criteria:

1. What knowledge is of most worth?
2. What in our culture must be reserved and deliberately renewed in both the core and ethos of our future civilisation?
3. What is dysfunctional, likely to be increasingly dysfunctional, and therefore should be cast aside?
4. What roles of educating everyone are our schools to play in this process of transcendence?

The first five criteria focus address the first three questions (content), the last one is addressed using the final three criteria that focus on teachers, pupils, and the learning context.

1. It's fit with the subject's epistemology

The first criteria is a contentious topic – the subject's forms of knowledge, which have been much debated. For example, McCormick's (1997) view was that the debate was between a process or content model for design and technology curriculum; later, Gibson (2008) proposed a conceptual framework showing the relationship between knowledge and skills; then more recently, Morrison-Love (2017) has presented an epistemology of technology education to define its curricular position. Morrison-Love's focus on technology leads to Broens and de Vries (2003) classification of technological knowledge, which like Vincenti's (1990) research draws from the professions rather than the school classroom, this does not negate their contribution to defining D&T's forms of knowledge. Rather, in my opinion, these two provide the answer, which I show as a continuum in Figure 2 with a Y-axis that adds McCormick's view of the place of conceptual and procedural knowledge in D&T.

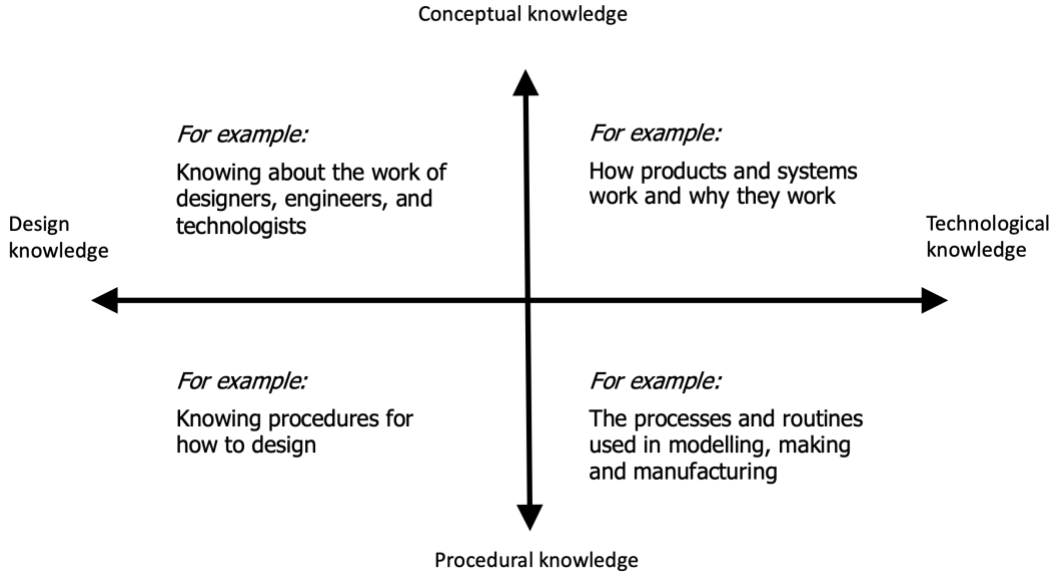

Figure 2 Forms of knowledge for D&T

Now, this will be a polemical model for some but taking on board my stated position earlier, that this whole process is both dialogical and about making sense, then it follows that there will be debate about D&T's forms of knowledge. However, it provides a basis for making sense about the proposed curriculum changes.

2. Fit with the subject's aims

For a new piece of content it would need to fit with the subject's aims. Analysis of the literature shows the subject has two overarching aims: first that it develops pupils design and technology capability, and second through studying D&T pupils develop a critical awareness of the technological world. Design and technology capability is defined by Kimbell and Stables as "the power to produce change and improvement in the made world" (Kimbell and Stables 2008, p.18). The second aim is about developing pupils' technological literacy (Dakers 2005; Keirl 2007). Pre-National Curriculum in England, Harrison emphasised the value of teaching pupils about technology as they were citizens in a technological society (Black and Harrison 1985). In terms of the philosophy of technology, this second aim could be seen as teaching pupils about technology as a volition (Vries 2005) and the first aim focuses on technology knowledge and processes, with the fourth category, artefacts, being included in both: the first as something pupils make when they are improving the made world, the second as an object of study.

The problem comes when the curriculum leans more towards one of these aims than the other, it is the two that make the D&T curriculum a valid subject as part of a general education.

A single piece of content will not meet either of these aims in totality, so the group needs to look at the proposed change in the whole of the curriculum. In other words, if this content were added or removed from the curriculum would this positively or negatively impact pupils' ability to intervene in the made world? If it's a new technological development, would they benefit from learning about it and its potential consequences on society or is this already included in the current curriculum content? An example of this is the inclusion of emerging technologies in the English National Curriculum, Helpfully, Barlex, Given and Steeg (2015, 2020) list examples of emerging technologies and examples are given in both versions but between the two publications some examples fade away, some emerge, and some are still emerging. It is this type of situation that the group must consider. One way round this, minimising the chance of overloading the curriculum with another new emerging technology, is to place the curriculum content in a concept group, like "emerging technology" or "shaping process" or "generating design ideas". But the very nature of the topics means these examples will be no longer be emerging technologies, they will just be technologies. Then they move into a category of 'current' technologies and later into 'historic' or 'redundant' (like the typewriter or Sony Walkman).

3. Inclusive curriculum

An inclusive curriculum is one which provides all pupils with "an equitable, equal, and high-quality education regardless of [their] characteristics, including race, ethnicity, social class, language use, gender, sexual orientation, religion, ability, and other human differences" (Mukminin, et al. 2019, p.55). Although Mukminin et al focus on the pupil, the teacher also needs providing with a curriculum that is inclusive to them (Prajapat, Sinclair and Hardy 2022). This means, instead of focussing on the "regardless" aspect, recognising and reflecting the diversity of the teacher and pupil communities is essential for an inclusive curriculum. For example, Gumbo (2022) argues that teaching indigenous contexts to both indigenous and non-indigenous pupils ensures justice for the indigenous learners decolonising the curriculum, which benefits all pupils

There are many facets to an inclusive curriculum, and the stakeholder group's dialogue would be challenging to ensure different characteristic, beyond Mukminin et al's list, were considered. Hellard (2023) draws attention to the religious-political dimensions implicit in artifacts and Axell and Boström (2021) show how the presentation of technology in young children's books reinforces gender stereotyping. There is an argument that these examples of artefacts should be used within the classroom to teach pupils about the values and biases hidden within them as this follows on from the subject's aims; therefore, by including them they provide opportunities for pupils to learn about the unintended consequences of technology (this relates to de Vries (2005) description of technology as volition).

Exploring whether proposed changes to content were inclusive would also need to consider pupils' abilities and capacity to engage with the content. If new content had potential challenges for teachers of pupils with special educational needs or young children, the stakeholder group could consider guiding teachers to make pedagogical choices that means the content is inclusive and provides their pupils with access to a high-quality curriculum.

Before moving on, it is important to note that this criterion is under-researched in the field of design and technology education.

4. Values

Values and their place in the design and technology curriculum are a key concept in terms of subject content and pedagogy. For example, Layton (1992b) identified different kinds of values that pupils need to learn about in D&T for use when making judgments, such as technical values, economic values and moral values; Trimingham (2008) shows the role of values in making design decisions and Prime (1993) presents a values framework for understanding new technologies. Martin (1999, p.202) categorises these as 'values within' D&T, but my analysis (2015) revealed that there are another two categories:

Values developed through D&T: How a pupil becomes technologically literate because of studying D&T (Dakers 2005, Keirl 2007).

Values ascribed to D&T: Layton's (1992a, p.3) second perspective was not as values within D&T but how the values systems of "stakeholders involved in the socio-political shaping of school technology" influence design and technological activity.

This latter category reinforces the need for a range of stakeholders involved in shaping the D&T curriculum. The second relates to pedagogical choices, which is discussed in a later criterion, but they also need to be explicit defined concerning the proposed change. So, the group must talk about how the proposed curriculum change aligns with these first two categories (values within and valued developed in).

5. Real-world: context and feasibility

Researchers in design and technology education have shown that pupils and students respond and engage more positively with authentic design contexts, that is ones that are real (For example Turnbull 2002; van As 2019; Hill 1998). They argue that through authentic design situations pupils are exposed to real-world contexts that are engaging and allow them to use and practice previously learnt procedural knowledge which then allows their design and technology capability to develop. This presents challenges for teachers determining a suitable context that has a suitable balance between giving pupils opportunities to make purposeful decisions with potential demands placed on teachers' time, materials, and equipment (Mawson 2003). Another risk is teaching pupils new knowledge, usually conceptual and technological, that is still being developed by technologists or in higher education labs, or that makes it impracticable to be taught in a school setting. An additional dimension to this is teaching pupils conceptual knowledge is "watered-down", or either ignores the science (Layton 1992a) or is too reliant on science-fiction. Although pupils do sometimes respond well to future worlds imagined in science fiction, the real-life contexts relate to the second criteria above "Fit with the subject's aims".

There is one final aspect to the need for proposed content changes to be "real" –pupils' motivation and engagement. Priniski, Hecht & Harackiewicz (2018, p.12) identify the potential of personal relevance on motivating students and "energising learning". Whilst there is not sufficient space here to explore the detail of their argument, it should be noted that there are three facets to "relevance" for Priniski, Hecht and Harackiewicz: personal association, personal usefulness and identity. This leads to the next two criteria: teachers having agency to interpret the proposed content changes appropriately for their pupils and school settings. As Davies argues:

"both a teacher's agency (their intended action) and school structures (the context within which they work) play a role in change" (2022, p.152).

6. Allows for teacher agency

Teachers are professionals, and to be a professional they need to have agency (Biesta, Priestley and Robinson 2015). One way of defining this in the context of a design and technology is that it means they can decide how to interpret the new content. Although the proposed curriculum changes maybe prescriptive – for example pupils learn about iterative design (Department of Education 2013), it cannot be that the teacher is expected to use it, teach in a particular way. In other words, can they decide to teach it in a way that is relevant for their context. Which leads onto the next two criteria.

A teacher decides what methods to teach knowledge, whether a process or concept, however the parameters of the teacher's decisions is criterion 2: is the pupil begin taught new knowledge to add another building block to their design and technological knowledge they can draw on to meet the aims of the subject.

7. Realistic for various locations and educational settings

The final criterion I am proposing is a practical. Can the proposed curriculum change be taught in different educational settings? Design and technology is a resource heavy subject, pupils often use a lot of "stuff" – machines, tools, materials and kits, as part of their learning and practice. Does the proposed change require new "stuff"? Can schools afford new "stuff"? Whilst exam boards consider the accessibility of new courses, curriculum designers do not always recognise this as a fundamental concern. On the ground, proposed changes are often driven by the richest schools (usually private ones), who have the time and physical resources (if needed) to experiment with new content, but state schools - particularly those for pupils with special educational needs, primary schools or specialist settings, do not. The group needs to remember the breadth of settings and access to resources (teachers, professional development and "stuff") when talking about the proposed changes. If each child is entitled to learn "the best that has been thought and said" (Department for Education and Gibb 2015), then surely proposed changes must consider the teaching and learning location.

Again, like criteria 3, the impact, challenges and considerations of educational settings, resources and facilities on pupils' progress and teachers' agency are under-researched in design and technology education.

CRITERIA IN PRACTICE: ARTIFICIAL INTELLIGENCE

Now the criteria have been established, the next thing to do is to consider how he next consideration is how would this work in practise.

Here I am going to reflect on how or whether AI meets the criteria above drawing on some published research (e.g., Axell and Boström 2023), professional magazines (e.g., Barrow 2024) and discussions on my own podcast (Hardy and Taylor 2024; Hardy 2024). But I have two notes of warning about what follows. First, there is no dialogue as its just me here although I'm drawing on the work of others, this is my interpretation, I am not making sense of AI as proposed earlier in this chapter. Second, AI is developing so fast that parts of my analysis may be dated before this chapter is published but that is why I think this is useful, to show how curriculum changes do not always keep pace with societal developments. Artificial intelligence is talked about in design and technology education by teachers, researcher, and exam boards but careful consideration is needed about its place in the curriculum.

Analysis of case studies written by D&T teachers show how they are exploring the use of AI for reducing time on teacher administration tasks, creating resources for the classroom, teaching text-to-image AI to pupils to generate ideas quickly (as discussed by Ringvold, et al. 2023), several mention its relevance arguing its use by designers today (like Federer in Barrow 2024). Each example relates to a different use within D&T: the first as a productivity tool for teachers exemplifying which could be used as a case study in the classroom; the second as a pedagogical tool, next as a design instrument and finally as an example of how it is begin developed as new knowledge by a design professional. Each is valid, but not all relate to the curriculum. I suggest the second does not relate to curriculum content, the first and last are examples of conceptual design knowledge, the third as a design instrument pupils can learn and chose to use when responding to a design context. As AI fits within the subject's epistemology, this means AI fits within the subject's epistemology - once pupils learn about AI in use (conceptual knowledge) and use AI (procedural knowledge), it can help address the subject's aims (criteria 2). However, if they only learn one form and not the other, then only one aim is met.

Whether it is inclusive is another matter. Ringvold et al (2023) highlight its limitations if pupils' have restricted vocabulary when using text-to-image AI and Axell and Boström (2023) conclude that stories created using AI about technology reinforce gender stereotypes. Does this mean AI should be avoided? No, but to counter these concerns the group may need to provide a narrative highlighting these two issues, the first to ensure an inclusive curriculum, the second as a potential learning point about in-built bias around gender, race and age (the latter two explored by Ringvold et al.).

This last point addresses the third criteria: values. Guidance indicating which values pertain to AI (Using the framework in Prime 1993, for example; or the taxonomy of disruptive technologies in Barlex, Steeg and Givens 2020) could help teachers plan how they teach pupils the values implicit within this new technology. But is the use of AI to generate designs (that is AI learnt as a design instrument) realistic? Might some pupils find the inability to realise their AI generated designs a demotivator? On the other hand, it might be a motivator for pupils who can visualise their ideas in their minds eye but do not (yet) have the capacity to sketch them. This is where the group might reflect on the still emerging aspect of AI regarding the produce-ability of designs as something to address so that for now the focus is more on case studies of AI and its potential to disrupt rather than as a design instrument. If they take this route, then where does that leave teacher agency? As the potential and use of AI is emerging so quickly, quicker than the group can meet and talk, there may need to be some future sensemaking extrapolating what might happen with AI to think about the choices a teacher can make when teaching AI in their own settings.

Finally, can AI be taught in different settings so that every pupil has an equal opportunity to learn? AI does need web based "stuff" rather than physical resources. But already I am assuming all schools have equal access to computers, tablets, and stable internet access. This is where teacher and senior leadership stakeholders need to represent different physical locations (city, rural and urban) together with types of education settings (mainstream and special schools, state and private, primary and secondary, and so on).

This is an example of how the criteria could be used to explore whether a proposed change to curriculum content should be added. Here I suggest some parts of the dialogue and potential ways forward if AI was put forward to the group. But I am only one voice representing one stakeholder group, dialogue would need to come from a wider group to ensure an agreement using the criteria.

CONCLUSION

This chapter responds to Irving Louis Horowitz's definition of a Festschrift as "a call to further work, effort, and energy, a call to the improvement of learning, of a discipline, a science, an artistic vision, or an intellectual position" in that it proposes a way of a collective improving the learning and discipline of design and technology education.

My proposal for the stakeholder group's membership, the framework for their dialogue and the criteria are presented here for debate. My purpose was to challenge the accepted processes that have led, in my opinion, to a diluted, overloaded and confused curriculum. My proposal would take effort from stakeholders to talk, listen, and make sense of proposed changes to the design and technology curriculum content. My aim here is to create a process that "transcends the pre-established mores that continue to dictate policy today" (Dakers, personal communication). I will leave it to the reader to decide whether it meets this aim.

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