Hyper Design Thinking: Critique, Praxis and Reflection

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Abstract A practice of critique, integrated with design as a 'disciplinary habit of mind' (Klebesadel and Kornetsky 2009, p. 99), sustains and hyperextends students' capacity for design thinking and metacognition. A forward-thinking, design-focused curriculum in design and technology education demands the evolution of such critical dispositions. Reflective thinking and writing practices unite creative and critical analysis with design process, enabling deeper engagement with praxis, metacognition and critique. This chapter observes how these critical, creative and reflective dialogic design-based thinking and writing practices, already employed in design and visual arts education, can augment design and technology curricula. Reflective practice and writing are able to enhance cyclic, critical and design thinking within design and technology curricula through the praxis-based application of critique. Practical methods to stimulate modes of design thinking and communication include critical, creative and reflective thinking and writing. Application of these dialogic methods occurs through opportunities for low-risk exploration through oral and written discourse within a critical and cylic design process. The integration of creative, critical and reflective thinking practices within a design process leads to the sustained reflexive habits and evolving critical dispositions crucial to design and technology education.

Keywords Critical thinking • Design thinking • Creative thinking • Reflective writing • Metacognition • Praxis

1 Introduction

Education researchers Klebesadel and Kornetsky (2009) describe 'critique' as 'a disciplinary habit of mind' (p. 99) within design and visual arts (D&A) education. Similarly, design and technology (D&T) educators engaging with the concept of critique aim for their student groups to develop critical dispositions, together

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with practices of sustained critical engagement. This chapter suggests that the philosophical concept of critique within this book can be practically applied within curriculum through praxis, reflection and augmentation of existing pedagogical practices. The integration of both the theory and practice (praxis) of critique offers an opportunity to enhance existing pedagogies and enable a renewed focus on the development of critical behaviours and dispositions within D&T education environments.

2 Critique in Design and Technology Education

Critique is interpreted here as a philosophically driven approach to design thinking where engagement is enabled through questioning and ongoing enquiry into design. Critical thinking is activated through systematic reflection and analysis: the construction of a series of questions. Critical attributes in D&T include but are not limited to what is traditionally termed 'critical thinking' in a broader educational context. In D&T, the individual, self-directed and cyclic nature of any design process requires the seeking of evidence from a wide range of student activities: close observation, design thinking, critical analysis and the evaluation of contextual issues and constraints. Alongside physical design development, there must also be a coherent discourse and communication of this conceptual design thinking, reflection and analysis and, finally, an ability to apply and adapt these evolving understandings in a practical sense through the construction of prototypes. Reflection is, therefore, an effective practical tool that can augment design thinking.

The term 'critique' in a D&T education context is used to define two subtly different modes of reflective design thinking: firstly, as a verb (Oxford English online dictionary, 2015) meaning to review something critically, to undertake a very close review or where a systematic, analytical assessment may be undertaken during a design process by the designer and, secondly, as a noun (OED, 2015) meaning to review the work of another designer or as is more common in design and visual arts (D&A) education as a form of review of design or artwork for assessment or examination purposes. In D&A, regular dialogic reflection (verbal or written) in relation to design development has been shown to enable critical thinking and enhance metacognition. In terms of the role reflection plays in metacognition within D&T education, Keirl (2005) suggests that 'critiquing aids selection of thinking styles' (p. 10). Thus, sophisticated critiquing is a form of metacognition. It is *both* reflective and deconstructive (echoing Sullivan 2010, pp. 107–108). In D&T the practice of critique (including reflection and praxis) could augment design thinking and support an emerging critical disposition. Similarly, Klebesadel and Kornetsky (2009) employ critique in D&A education as 'a formative mode of feedback' (p. 101), with metacognition as the goal. Here lies further potential for the application of critique in D&T education, as a reflective and formative

mode of feedback within design. Design is a highly individualised and non-linear sequence, so tracing evidence of critical engagement can be complex. The concurrent or cyclical nature of this process means that 'critical thinking' and any written, oral or diagrammatic communication could optimally occur in parallel to design development. Situating critique within D&T offers educators the opportunity to encourage the development of attributes including critical thinking, reflective thinking and communication skills that are manifested through design thinking.

3   Design Thinking and Metacognition

In D&T education students are encouraged to develop their design thinking skills through design development. Ideally, the evolution of these skills includes an emerging critical capacity. It is this analytical aspect of design thinking that can be enriched by a theoretical understanding and practical application of critique. The concept of critique could be prioritised within design thinking (or the conceptual side of design development as a core D&T pedagogy) and that this can be done effectively through augmentation of existing pedagogical approaches to design development (including D&T folios, e-portfolios, project work, other documentations including evaluations of design solutions and prototype development). Critique represents the vital nexus between 'making' and 'knowing' in D&T education, and this can be supported and evidenced through simultaneous prototype development and language-based reflection, communication and critique of design.

The term 'design thinking' as a noun can be defined as 'the act or practice of using your mind to consider design' (Ambrose 2010, p. 1). Further, that 'design is an iterative process and design thinking is present in each stage of the journey . . .' (Ambrose 2010, p. 6). This iterative process includes the following aspects: stages of thinking, research, idea generation, refinement, prototyping and implementation. Whilst Ambrose (2010) and others have described 'stages' of design, in the context of critique, it is essential that the so-called stages are seen as indicative and non-linear. There can be no strict order by which design thinking or a design problem is solved because there is no 'the' design process only 'a' design process that is infinitely variable in accordance to the individual designer and their unique approach to design thinking. Design is an inherently reflective and creative process that encourages metacognition or inspires students to ask questions, take risks in their design experimentation and reflect upon their unique approach. Advanced design thinking assimilates a highly individual analysis of a student's unique design thinking or design development approach, another way to describe metacognition. In the best sense, metacognition organically encourages criticality. Metacognition within D&T education can be activated by a practice of conscious critique, praxis and reflection.

4   Critique: Making or Knowing?

Whilst reflection is incorporated to some extent in D&T education, its potential as a metacognitive tool capable of enhancing the learner's critical thinking, critique, praxis and reflection has perhaps not yet been fully realised. Traditionally, subject choices like D&T and D&A are considered practical rather than theoretical and less dependent on skills that may be perceived as academic, such as writing. As Owen-Jackson (2013) asserts: 'subjects focused on knowledge are perceived as "academic" and those focused on skills as "practical"' (p. 64). Consequently, some students are drawn to these areas in avoidance of formal academic writing assessment tasks, as Childers et al. (1998), Orr et al. (2004) and Owen-Jackson (2013) have identified. Orr et al. (2004) also go on to say that in their field (design and visual arts education research), 'the role of writing [has been] questioned' (p. 75). There is a viewpoint that through the artefact, the student communicates without the use of verbal language, using a visual language that is 'wordless'. However, the reality – shared by D&A and D&T – is that the curricula require students to 'create, design and write' (Orr et al. 2004, p. 75). Furthermore, of crucial importance is the knowledge that curricula 'are assessed via the textual and the visual' (Orr and Blythman 2002, p. 1).

In a recent publication, *Debates in Design and Technology Education*, Martin and Owen-Jackson (Owen-Jackson 2013) pose the question: 'Is design and technology about making or knowing?' (p. 64). Exploring the dichotomy within an England-specific context, Martin et al. (Owen-Jackson 2013) describe how it continues to exist within D&T education. They contend that such a separation is counter-productive, instead suggesting, 'it is the combined effect of both [making and knowing] working together that supports successful designing and making' (Owen-Jackson 2013, p. 71). They conclude by reinforcing the inherently 'dynamic' nature of the subject (Owen-Jackson 2013, p. 71). John Wood (2008), design theorist and educator, echoes this sentiment by proposing that 'designers can reunite "saying" and "showing"' (p. 304). The notion of critique, as explored in this book, relates to both theory (knowing) and practice (making). It offers an approach which is both philosophical and practically applicable, mirroring the very nature of design thinking and thus circumventing the perceived dichotomy between making and knowing that so concerned Martin and Owen-Jackson (2013).

5   Defining Critique in Design and Technology Education

Critique is not limited to or defined by one aspect of learning in D&T. Instead, it affords a broad-reaching, philosophically informed means for educators to embed more opportunities for the emergence of critical dispositions within all aspects of the learning. One affordance offered by an engagement with critique is a shift away from the traditional dichotomy between 'making' and 'knowing' or 'skills' and 'knowledge'. For the philosophy of critique, it necessarily applies to both: it is

about an exchange between the two – or the 'praxis'. It can, therefore, facilitate a shift towards a more sound interpretation of the nexus between theory and practice in D&T education.

6 Modes of Reflection in D&T Education

Whilst the concept of reflection is well known to educators as it is found in their own practice – discussed in chapter "Critiquing Teaching: Developing Critique Through Critical Reflection and Reflexive Practice" by Susan McLaren – it is less commonly identified and applied as a highly beneficial element in *student* learning. Moon (2013) defines the difference between these two modes as (a) reflection in learning and (b) reflection in professional development and considers 'reflection' to be 'a technique for aiding and reinforcing learning, used in education and professional development' (p. vii). This discussion examines the benefits of requiring students to engage in a practice of written or verbal reflection, and it will also specifically address the notion of 'critique': the rich learning and linkages which occur when both teacher and student are simultaneously undertaking reflective practice. For the purposes of this discussion, the terms 'reflective practice for educators', 'reflective practice for students' and 'critique' have been used to distinguish between the three key concepts. Thus, the term 'reflection' is used in this chapter as an umbrella term for both (a) reflective verbal (oral) or (b) written language-based communication methods (Sullivan 2010, p. 100) and also techniques like critique, or 'crit' in a D&A context, language-based reflection (Sullivan 2010, pp. 110–111), non-linear (Wood 2004) and reflective writing methods. It suggests that many of these critic-reflective verbal or written communication methods can support and augment design thinking and could therefore be adapted to D&T education.

7 Praxis in Education

The term praxis, in an educational context, has been defined as:

> An active, continuous process of critical action and reflection upon accepted knowledge, experiences, and perceptions of reality in order to transform reality. (Collins & O'Brien 2011, p. 363)

In their definitions Collins and O'Brien (2011) cite Freire who considered the notion to be cyclical when used in a practical pedagogy, where: 'The process involves a cycle of reflection and action based on that reflection, followed by further reflection' (pp. 363–364).

Critique is related to praxis through its definition of a 'nexus' between theory and practice in D&A and by its philosophical and reflective nature, including the ethical attributes alluded to by Freire and others. Freire described how reflective

praxis activates a more 'critical consciousness' which he called the process of 'conscientisation'. He suggests that this occurs:

> when adults are … critically discussing an issue, acting on that discussion, and then reflecting on that action before moving to act again. (Freire 1970, cited by Collins and O'Brien 2011, p. 96)

The concept of praxis is innately related to practices of critique and reflection within design thinking. Praxis can supplement cognition of critique within a D&T context by illuminating the operation of a dynamic intersection between theory and practice. Praxis is supported by the cyclical reflection that mirrors design thinking, suggesting that reflection is the crucial conduit for both praxis and critique. The application of these terms, and their capacity to inform and complement each other, offers D&T educators an energetic critical methodology innately suited to design (and design thinking): a practical and adaptable support structure for thinking and learning more comprehensively.

8 The Link Between Praxis and Reflection

In D&A education, reflection in the shape of reflective thinking and reflective writing and verbal communication in the form of 'crits' have been utilised to encourage and support praxis. Reflective thinking and writing have been used to support student understanding of praxis or the interrelationship between theory and practice within their own design thinking. In D&A education praxis is described as the dynamic relationship between concept (theory or ideas behind making) and process (practice or the act of making and working with physical materials). The perceived dichotomy between 'making' and 'knowing' present in D&T is echoed in the discipline of D&A education.

> rather than constructing a false and arbitrary dichotomy between knowing and doing, knowledge and action, theory and practice, they rather sought to find a braiding and to further explore issues of reflective practice. (Orr et al. 2010, p. 199)

One of the most significant insights that has emerged through this research into the formative role of reflective writing in D&A education[1] is the auxiliary role of reflective practice in both the maintenance of praxis and the emergence

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[1]This research was initiated at Goldsmiths college, University of London, UK, through a research project called 'Writing Pad' www.writing-pad.ac.uk/; this led to the development of Writing Pad (2007). *Journal of Writing in Creative Practice* (Intellect, UK). The Writing Pad project included an extensive list of international partner institutions. Another significant research has been published by LTSN Subject Centre for Art, Design & Communication (2002) (*Art, Design & Communication in Higher Education (Online) Art, Design & Communication in Higher Education*) (Intellect, UK), including a special guest edited a two-part edition (2004) *Textual and Visual Interfaces in Art and Design Education* and an *International Centre for Learning and Teaching in Art and Design* (CLTAD), University of the Arts, London conference including (2010) *Creative Parternships: helping creative writing and visual practice students to make*

of a critical disposition. Reflective practice in D&A occurs through a wide range of different modes including oral and written modes and individual and/or group communication. Reflection in its many different modes is an active process that can hold up a mirror to or actively enable critique to occur alongside design thinking within a process of design. Here lies its potential within D&T education in support of critique. Lockheart (2010) describes this potential in relation to reflective writing, in which:

> one purpose . . . is discovery: learning whilst doing, as opposed to writing up when the learning is complete . . . highlight (ing) that this not only develops writing, but also reading across different modes of doing and thinking. Indeed their article refuses the separation of text and artifact, and suggests that imaginative multimodal approaches to learning are the only way to continue to serve the truly reflective practitioner. (pp. 194–195)

The Australian Curriculum, Assessment and Reporting Authority (ACARA 2012) defines a multimodal text as a 'combination of two or more communication modes (for example, print, image and spoken text, as in film or computer presentations' (p. 13). In a D&A education context, multimodal refers to the use of reflective writing alongside or within a D&A sketchbook: another 'signature' pedagogy that operates alongside critique or 'crit' sessions within D&A (Sims and Shreeve 2012, pp. 62–63). In a D&T education context, this 'multimodal' approach could be applied through a wide variety of different analogue or digital communication methods including interactive platforms like e-portfolios (pioneering work in e-portoflios has been done by the Technology Education Research Unit (TERU), Goldsmiths college, University of London, UK, through their 'unpickled' and 'e-scape' research and development programmes and extensive development work in the use and design of e-portfolios New Zealand (for an overview, see Kimbell 2012, Kimbell and Stables 2008, Stables and Kimbell 2000, Williams 2012; Williams and Newhouse 2013, Edwards 2015).[2] It is this understanding of how these practices of reflection and communication that focus on praxis and operate in relation to design and design thinking that offer clear examples of how D&T educators might augment their pedagogies in similar ways.

9 Critique Within a Design and Visual Arts Context

It is not solely in a D&T context that the terminology being discussed is useful. In design and visual arts (D&A) education, praxis has become a normative way to describe the complex interrelationship between theory and practice. Significantly,

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it has been used where the practice of design or visual arts is defined as a form of research (Barrett 2010; Sullivan 2010; Carter 2004). Arguably, all design is a form of research in the sense that it requires speculation, testing, analysis, evaluation and reflection. If we consider 'design' to be the primary focus of D&T education and then consider the number of different practical and theoretical tasks that need to be undertaken to ensure a well-developed design concept and prototype, it is clear that a constant exchange between theory and practice is required. Critique offers us a way to understand and influence that exchange and to support praxis. Some examples of approaches developed within D&A that could be applied to or adapted for D&T are considered within this chapter.

10   Critical Thinking as a *Defining Concept* of the University

Critical thinking has been described as a 'defining' (Barnett 1997) concept of the university, yet the skills for the comprehension and application of critical thinking may easily be assumed by educators within their pedagogical practices and curriculum design in all fields. Adaptation of critique seems to offer D&T educators the opportunity to teach and reinforce the importance of critical thinking, thus enabling the development of essential critical dispositions in students. And this focus on critical thinking is not limited to higher education. For instance, the Australian Curriculum, Assessment and Reporting Authority (ACARA 2012), has recently published the new Australian national curriculum for design and technologies, 'The Shape of the Australian Curriculum: Technologies'. This policy document clearly outlines critical thinking as a key dispositional attribute within D&T education (ACARA 2012) at both junior and senior levels. Here, creative and critical thinking is placed side by side and their roles are described together: 'Critical and creative thinking underpin learning in Technologies...' (ACARA 2012, pp. 26–27)[3]. What is significant here is the brevity of the description, presupposing comprehension of the term by educators. Education researcher Jennifer Moon (2008) reminds us that critical thinking, however, is 'not often explicitly taken into consideration in pedagogy', and yet it is usually very evident in the 'rhetoric of education, particularly higher education' (p. vii). This, at least within D&T education, is why critique offers us an opportunity to augment existing pedagogies, together with a specific, design-driven critical thinking vocabulary and practice.

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[3]For the full quote, please refer to http://www.acara.edu.au/verve/_resources/Shape_of_the_Australian_Curriculum_-_Technologies_-_August_2012.pdf, p.26–27.

Table 1 List of graduate attributes related to critical thinking

Australian HE institution	Hierarchical placement	Graduate attribute
University of Technology, Sydney	Listed as the (1) first graduate attribute under 'intellectual (practice oriented)'	(1) *Critical* and independent thinking
University of New South Wales	Listed as (a) first graduate attribute	(a) Scholars capable of independent and collaborative enquiry, rigorous in their analysis, *critique* and reflection, and able to innovate by applying their knowledge and skills to the solution of novel as well as routine problems
Australian Catholic University	Listed as no. (4) nb Ethical graduate attributes are listed above which are uncommon in the Australian HE context due to the specific ethical focus of this national institution	(4) Think *critically* and reflectively

When Moon (2008) conducted an extensive literature review on the significance of critical thinking in higher education, she concluded that:

> Critical thinking is considered to be central to higher levels of education or a fundamental goal of learning (citing Kuhn 1999; Kelley and Shemberg 1995) (p. 6).

Moon (2008, p. 7) suggests higher education in particular has assumed the term with 'missionary zeal' as a graduate 'objective' and cites many examples from higher education institutions in the UK and the USA. Such enthusiasm is quickly evidenced in an Australian higher education context through the hierarchical arrangement of graduate attributes (Table 1).

The University of Technology (Sydney, Australia) also lists critical thinking and creativity in their grade descriptors when defining what constitutes a 'high distinction' for assessment purposes. The two pertinent points in this descriptor that distinguish a high distinction from other grades that may be awarded are:

(a) 'By means of criticism' [or evidence of a disposition of critique].
(b) 'This grade may also be given to recognise particular originality or creativity'[4].

It is interesting to note in this context that the term critical thinking is also often situated within education policy documents alongside another ambiguous term: 'creativity', just as it is in the new ACARA D&T curriculum (2012) cited above. A detailed examination of the relationship between critique, critical thinking and creativity lies beyond the scope of this chapter but would be well worth investigating further, especially in light of the success of more creative reflective writing methods

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[4]For the full descriptor, please refer to http://www.gsu.uts.edu.au/rules/student/schedule-2.html.

used in D&A (von Mengersen 2013, 2015). Padget (2013, pp. 2–3) has explored the cognitive relationship between creativity and critical thinking, describing it as 'symbyotic' and noting how creativity, critical thinking and reflection actively cross reference in an engaged learning environment. The brief analysis of evidence from an Australian D&T education context, above, supports the findings of educational researchers like Moon (2008) and Barnett (1997), highlighting the inconsistency between aspirational educational rhetoric and the reality of assumption, the lack of explicit pedagogy and the need for greater clarity (and discipline specificity) of an enigmatic yet vital term. Here, within D&T education, there is perhaps an opportunity to differentiate between 'critical thinking' and 'critique', to redefine these terms from a discipline-specific perspective and to reconfigure practical learning activities that support the role of critique in design thinking.

11   Critique in the Australian Design and Technology Education Context

In Australia, critique emerged during the rewriting of the South Australian design and technology curriculum in 2001 – discussed in chapter "Critiquing as Design and Technology Curriculum Journey: History, Theory, Politics and Potential" by Steve Keirl. At that time it became an integral third strand in a non-hierarchical list within the policy including critiquing, designing and making. The relationship is considered further:

> These three strands *are interdependent and none of them is predominant*. Read alongside each other *they do not constitute a sequential process*. They interrelate to support rich understandings. A quality Design and Technology education weaves the three into a dynamic and holistic learning experience *for all students*. (Keirl 2001, South Australia Department of Education, Training and Employment (DETE), as cited in Chapter 7 by Kierl)

The inclusion of critique can be seen here as supporting a more holistic, dynamic and inclusive learning experience. Critique is about reflection as a component of critical design thinking, involving thinking across theory and practice (praxis). Ideally, the inclusion of all three strands in this non-hierarchical way allows for different learning styles and the design of flexible curriculum through critiquing. It should be delivered and assessed through alternative verbal or written modes to support inclusive and individual learning for students at any stage or age (Broughman and Hunt 2013). In D&T, critique is used in this way to offer valuable formative feedback and 'low-risk writing opportunities' (Broughman and Hunt 2013, p. 188) for students undergoing project development. This enables the building of skills, vocabulary and comprehension: critique as evident in the complex exchange between designing, thinking and making.

12   Critique as a 'Signature' Pedagogical Practice in Design and Art

Klebesadel and Kornetsky (2009) describe critique, or the 'crit', as a 'signature pedagogy in Art and Design' (p. iii), which operates as 'a formative mode of feedback' (p. 101). As a signature pedagogical practice, critique is seen as 'essential to developing a self-critical habit of mind, inculcating current value systems in art and design and enabling students to position themselves within professional practice' (Sims and Shreeve 2012, p. 61). Within D&A education contexts, critique is often used to describe a show-and-tell session where students and educators meet together to discuss the evolution of design ideas, show prototypes or illustrations and participate in a dialogic 'critique' through analysis and constructive criticism. 'Crit' sessions vary depending upon the emphasis of the educator and may focus on 'evaluating works in progress or completed works' (Sims and Shreeve 2012, p. 61) and on teacher feedback or peer feedback and discussion. These sessions are understood to be formative feedback opportunities which enhance metadesign (Wood 2008) thinking and metacognition through oral communication and subsequent reflection. This is an example of how a metadesign (Wood 2008) approach and a 're-languaging' (Wood 2013) of design towards a more communicative or 'dialogic' (Bain 2012) approach could augment existing design pedagogies within D&T education.

13   Metadesign and Re-languaging

Lockheart and Wood (Lockheart and Raein 2012), founders and editors of the Intellect journal *Writing in Creative Practice*, conclude, after 10 years of research in D&A education, that language and literacy remain the keys to reflection and reflective writing practices that augment design thinking. They have described their ongoing interest in the 'designerly' (Cross 1982) use of language and the role of writing for designers and how it can inform students about their own practice through creative and critical thinking. They assert the importance of 'languaging' (Lockheart and Raein 2012, p. 285) in the evolution of a design research process. Wood has introduced two new terms into the vernacular of design thinking that call for a more critical, dialogic, reflective, ethical, creative and multidimensional approach: 'metadesign' (2008) and the 're-languaging' [of design] (2013). These terms are useful for D&T education in relation to critique because they present design and design thinking as a non-linear approach informed by critique, praxis and reflection.

   Wood has developed an approach to design practice called 'metadesign' (Wood 2008, 2011, 2013;) which encourages a critico-ethical approach to design and looks at how design operates within complex systems. According to Wood (2004, p. 175), metadesign 'requires' ethical attributes. Wood (2008) considers metadesign to focus

on 'an outcome-centred mode of reasoning' which 'advocates a comprehensive superset of practices... in which "design as planning" would be replaced by "design as seeding process"' (p. 307). Wood aimed to (a) encourage designers and design students to take a more reflective, ethical and sustainable approach to design thinking, (b) to encourage designers and design students to ask more questions and be more critical of the socio-economic contexts in which they are working and (c) to thus encourage metadesign and metacognition (including critique and reflexivity).[5] Von Mengersen (2013, 2015) has identified timing and vocabulary as two key factors that enhance the use of reflection as a pedagogical practice within D&A education. Therefore, in seeking to equip students with the skills for critique, praxis and reflection, it seems necessary to provide not only formative assessment opportunities but also the appropriate metalanguage for expression and understanding. Lockheart and Wood's focus on 'languaging' (Lockheart and Raein 2012, p. 285) that encompasses key terminologies that students can use to demonstrate higher-order thinking in relation to their design process, like Wood's 're-languaging' (2013).

With this second term 're-languaging', Wood (2013) suggests a re-examination of the very nature of designing:

> the re-designing of design to be more relational and combinatorial, so that its primary focus is more associated with the co-creative relations between things, rather than on individual products or services... metadesign is intended to help designers to re-think the habits, assumptions and discourses that seem 'normal'. (p. 59)

In D&T education, just as in other disciplines, students' skills and vocabulary for the practice of critique, praxis and reflection can easily be assumed, embedded as they are in tasks like the selection and application of cognitive organisers. Reflective communication practices (verbal or written) for critique developed in D&A education suggest that the practice of reflective forms of communication including critique should be regular, cyclic, formative and intrinsic to every stage of design thinking and, further, that specific vocabulary for reflection, praxis and critique needs to be developed. It is evident that both fields (D&T and D&A) are concurrently seeking to move beyond the dichotomy of 'making' or 'knowing' towards refined literacy terminologies and communicative community-based or 'dialogic' (Bain 2012) modes of design development and assessment. A discussion of assessment practices lies beyond the scope of this chapter but is another important aspect that could be analysed in relation to these findings.

Many design researchers are calling for a more 'dialogic' (Bain 2012), 'autodidactic' (Wood 2013), 'critico-ethical' (Wood 2008), 'combinative' and 'co-creative' (Wood 2013) approach or a language-driven, community-of-practice approach to design thinking and practice. Authentic reflective practices are vital, documenting a shift in student perspective and awareness – Harfield (2012) describes this as 'transformative learning' and Atkinson (2012) as 'the intangible designerly thinking' or 'tacit design intelligence' where creative problem solving occurs;

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[5]For more information, refer to the Metadesigners network: http://metadesigners.org/HomePage

Bain (2012) suggests it opens up a more 'dialogic' assessment practice which allows students to take more risks in design development. Significantly, all of these skills in terms of the opening up of student perception in design thinking have also have been linked to what these researchers call the capacity for 'lifelong learning' or 'self-learning' (Harfield, 2012) or 'autonomous learning' (Bain 2012).

Critical literacy in this context thus appears to be crucial to the meaningfulness of critique, reflection and praxis for D&T education. Keirl (2005) suggests that critique is expressly linked to 'more powerful meaning-making opportunities for students' learnings about technologies' (p. 1). If it is the students' vocabularies (through verbal or written modes) that make their cognition and meaning-making visible to us, the educators, then arguably, we enrich and augment the pedagogy in this area of D&T education through critique. Padget describes his 'belief in the primacy of language in the learning process and how this links with creative learning and teaching and critical thinking' (Padget 2013, p. xi) – therefore, highlighting the point that without precise, specific metalanguage with which to articulate their learning, students' efforts cannot be either fully expressed or adequately measured. In reality, and for the purpose of summative assessment particularly, our students must demonstrate and communicate what they know through at least one language-based mode alongside artefacts or prototypes. Also, see the discussion in chapter "Modelling as a Form of Critique" by Niall Seery of 'Modelling as a Form of Critique', in particular for the discussion of cognitive and related physical manifestations which support an external and internal dialectic.

Writing is an assumed mode of communication in many D&T assessment models, including written exams and digital or analogue design portfolios; therefore, a focus on vocabulary development for critique, reflection and praxis is logical. For Wood (2013), 're-languaging' is an active form of critique that focuses on a dialogic community of practice enabling the evolution of individual and group thinking and thus metacognition, through reflection and language usage. Wood has focused on developing a 'culture' of critique that augments existing design paradigms and pedagogies, expanding well beyond many of the commonly stated 'stages' of design thinking. Wood's 'metadesign' (2008) and 're-languaging' (2013) methodologies offer scaffolds for redesigning design thinking and learning within D&T education.

14 Critique, Praxis and Reflection in Design and Visual Arts (D&A) Education

Design (and visual arts) education shares a history of using critique, particularly in relation to the term *praxis*. Sullivan (2010) describes how the actions of create-critique work in association within the visual arts. He analyses different versions of the theory/practice relationship or what he terms 'dimensions of practice between theory' (Sullivan 2010, p. 106). This theory relates to what he has called the create-critique dynamic, in which:

visual arts practice and critical components are linked as theoretical issues and investigated through creating and critiquing; [and, where] theoretical interests are investigated through a cycle of processes involving issues and context. (Sullivan 2010, p. 106)

Pointedly, Sullivan (2010) then goes on to describe how this create-critique dynamic is dependent upon 'language-based methods' (p. 107). He describes three different 'domains of practice around inquiry' including:

(a) Discursive – in which visual forms are developed
(b) Dialectical – the use of language-based methods to assess the adequacy of arguments, claims and actions (in the studio, visual forms of language such as metaphor and analogy are used to challenge and change things)
(c) Deconstruction – methods that critique areas of emphasis and omission in systems and structures (in studio contexts, visual and verbal methods are used to embody meanings that explain how things are and how they might be)

Orr and Blythman (2002) proposed that the practice of reflective writing parallels the practice of designing and suggested that reflective writing (or other modes of language-based communication) can operate effectively within the practice-theory loop (praxis). In this context, they suggest that writing for reflection can enable more effective learning when: (a) it is being used regularly to build up skills and confidence, (b) it is linked to both formative and summative assessment tasks (primary and secondary reflective practice) and Francis (2009, p. 36) adds (c) when it is clearly linked to [a students'] personal endeavour. In D&A education many researchers and educators have experimented with more creative verbal and written modes of reflection that can operate alongside or in parallel to the 'crit'. Here, students are encouraged to speculate upon what questions may arise during their 'crit' and then later reflect upon those anticipated and unanticipated questions that did arise. Instead of formal writing methods, these educators use informal ones including creative and non-linear or multimodal writing techniques, developed at a formative stage. Others have developed visual or diagrammatic methods. Creative, reflective writing models can enhance learning journals and other reflective writing practices. Potentially, they may support reflective writing practices within technology by offering more approachable, logical and arguably less-formal methods for *thinking* through writing.

One of the crucial factors in both D&T and D&A education is the capacity to think speculatively so that reflection here is not limited solely to a reflection of that which has past but towards a future thinking and speculative nature: a critique of possibilities. Sims and Shreeve (2012, p. 57) describe how in D&A education the conversations between student and educator 'often deal with indeterminate and unknown creative outcomes' or what (cited by Sims and Shreeve 2012) described as 'pedagogies of ambiguity' and (cited by Sims and Shreeve 2012) as uncertainty. Reflection, praxis and critique can augment D&T education in support of this necessary creative, questioning and speculative mode of design thinking. Akin to Keirl's (2005) description, 'critiquing is about questioning rather than answering' (p. 8) and also related to Atkin's term 'anticipatory thinking' (2012). Indeed, it

is this aspect of critique that may be one of the most important in terms of D&T education and metacognition, whereby the emergence of a critical disposition signals the capacity for both autonomous learning (Bain 2012), another poignant aspirational graduate attribute that often sits alongside 'critical thinking'.

15 The Tetrahedron: Non-linear Writing Models for Design

In the 'tetrahedron' model of design, Wood (2004) describes a non-linear method of creative writing that he suggests is 'a productive way to explore and guide the practice of design' which can be 'applied to help designers become more self-reflexive' (p. 175). The method does not subscribe to normative academic writing conventions. Instead, it encourages writing as a critical practice that is more 'purpose defined, outcome-centred, reader-empathic, and self-reflexive' (Wood 2004, p. 175). In relation to critique, Wood (2004, p. 175) offers us a timely reminder of the 'autodidactic' and thus metacognitive potential of the writing process. D&A educators have described the reflective, metacognitive and critical benefits of verbal and/or written communication methods in their discipline. It is these communication methods that can be adapted for use in D&T education curricula, in particular where the focus is on self-directed design development. Wood (2004) describes a practice of non-linear writing, effective for use alongside design, to support critical design thinking, suggesting that this approach supports praxis and 'self-reflexivity'. Wood (2004) is optimistic about what he describes as the most important contextual issue in his research: 'the familiar tension between what we clumsily polarize as "practice" and "theory"' (p. 179). He outlines historical reasons for the development of this dichotomy, particularly in a university context. He suggests that because this dichotomy still exists, 'the cultures of doing or making and thinking or writing have yet to be integrated in an optimal way' (Wood 2004, p. 179). The terms that Wood has created such as metadesign and the tetrahedron model of writing for design and re-languaging suggest methods for shifting beyond this dichotomy towards increasing praxis and reflection in design thinking.

This optimism and these methods also offer opportunity for the development of critique within D&T, as Wood (2004) reflects: 'fortunately . . . positions are merging slowly into a more reflective discourse of praxis. Art and design education has been important in pointing the way to a healthy fusion of these two systems of thought and action' (p. 179). Evidence of this fusion, particularly in terms of the relationship between critique, praxis and reflection, can be seen in D&A education through the work of Wood (2004), Moon (2006), Francis (2009) and others who have developed a variety of non-linear design thinking exercises based on dialogic language, creative writing and multimodal methods which encourage students to find methods that suit their own learning. Moon's (2006, pp. 26–35) research looks at how these tasks can be used to encourage more consistent use of learning journals among students of all age groups and in a range of disciplines. She describes how students' learning occurs through the regular use of learning journals

alongside project work, suggesting that such work offers many benefits including slowing the pace of learning [increasing time for reflection], increasing the sense of ownership of learning, acknowledging the role of emotion in learning, giving learners an experience of dealing with ill-structured material of learning [where design is a pedagogy of ambiguity and/or uncertainty], encouraging metacognition and enhancing learning through the [autodidactic] process of writing.

Francis (2009) and Moon (2006) have explored tasks that focus on non-linear creative design development and critical design thinking – and it is these that could also be used to augment design development pedagogies within D&T education. The following (see Table 2) have been identified as useful non-linear writing tasks within a studio-writing research project (von Mengersen, 2010–2015). These have

Table 2 List of creative design thinking and dialogic writing tasks

Task	Reference/s	Summary of approach
Use questions	Moon (2006), p. 142; Johns (1994)	'Questions help learners to get started in reflecting or to deepen their reflection' (Moon 2006, p. 142)
		Develop a set of programme-specific learning journal (or reflective) questions involving the writer (Johns 1994, p. 71–5)
Generate questions	Moon (2006), p. 142 citing Hahnemann (1986)	'An intermediate stage between the use of preposed questions and unstructured writing is to ask learners to develop their own questions' (Moon 2006, p. 142)
		Pat Francis calls these reflectionnaires (Francis 2009, p. 51)
Concept mapping or graphic representation of ideas	Moon (2006)	'A concept map encapsulates an idea and the themes radiate from the main idea and subdivide hierarchically' (Moon 2006, p. 143)
Writing lists	Francis (2009)	Lists are a 'way of limbering up and helping develop associations' (Francis 2009, p. 105)
		Non-hierarchical lists including a spiral (Francis 2009, p. 96), the plait (Francis 2009, p. 97), the daisy metaphor (Francis 2009, p. 98–99)
		Vocabulary extension including mnemonics (Francis 2009, p. 127), creating words (Francis 2009, p. 130–131), repetition (Francis 2009, p. 135), nouns and verbs (Francis 2009, p. 138–139)
Free-flowing or stream-of-consciousness writing	Moon (2006) citing Elbow (1973)	This process can be used as a less-formal warm-up (Moon 2006, p. 143)
Take a sentence	Moon (2006) citing Hahnemann (1986)	'Hahnemann (1986) asks her students to "take one sentence . . . and write on its meaning"' (Moon 2006, p. 144)

Table 2 (continued)

Task	Reference/s	Summary of approach
Draw or map a research process	Moon (2006)/visualising research (Gray and Malins 2004)	'Draw your project' (Moon 2006, p. 151)
		'Undertaking a contextual review: mapping the terrain', visual models of mapping research (Gray and Malins 2004, p. 48–64)
Draw an image	Moon (2006, p.150)	'Progoff uses the drawing of images to facilitate reflection or to summarise a session of reflection' (Moon 2006, p. 150)
Write a poem	Moon (2006)/create textual ontology (Hall 2012)	'The writing of poetry can enable the emotional content of a topic to be more freely expressed' (Moon 2006, p. 157)
		'A poetics of textual practice may . . . encourage student designers to put more meaning into their writing by making challenges to form' (Hall 2012, p. 365–366)

been integrated into a fully online class for cross-disciplinary design and visual arts students. These tasks have been tested in this context specifically in terms of how they assist individual design development and design thinking where students are working on self-directed projects. All of these have been found to increase the students' capacity for critique, praxis and reflection and have been tested over a period of 6 years within a D&A higher education context.

These new terms – metadesign and the tetrahedron model of writing for design and re-languaging (Wood) – all rely upon creative, non-linear design thinking and 'languaging' methods. Moon, Wood, von Mengersen and others suggest that it is these non-linear dialogic methods that teach students to expose the connection between critique, praxis and reflection in design thinking and practice. The inherent feeling of optimism suggested by Wood (and others) in response to their success with D&A education students offers a clear proposal as to how D&T educational pedagogies could be augmented by thoughtful inclusion of critique, praxis and reflection. In this way we might begin to bridge the gap in a dichotomy between 'making' and 'knowing' and move towards an emerging disposition of critique which includes more meaningful and dialogic design thinking and critical comprehension, communicated through multimodal languaging methods to mirror the uniquely non-linear nature of design practice.

16   Conclusion

The nature of critique is ongoing inquiry, where the construction of dialogic questions is primary. This may even be the very definition of what determines a critical disposition within D&T education. This kind of philosophical approach to critique can augment existing D&T pedagogical practices and underpin the integration of praxis and reflection. Praxis offers a more evolved approach to the dated dichotomy between 'making' and 'knowing' that has traditionally existed within D&T education. Reflection can be used to describe a wide range of language-based verbal or written modes of communication. It seems logical for critique to evolve into a 'signature' pedagogical practice which offers formative feedback opportunities, with the broader aim of encouraging higher-order thinking and lifelong learning, and above all seeks the emergence of a disposition of inquiry. Dialogic reflection can augment design thinking and practice by enabling praxis and critique, thus encouraging the emergence of metacognitive processes through expanding vocabulary, technological literacy and evolving critical insight. This chapter suggests that some of the key factors enabling this application and evolution of critique to augment design thinking and existing D&T pedagogies are praxis and reflection. To reinforce these, it also suggests that the timing of formative feedback opportunities, a focus on conscious vocabulary development for critique (equipping students with the language literacy and terminology for accurate, more meaningful engagement and self-awareness), and the use of more creative and less declarative modes of communication appear to be significant. A focus on critique aims to embed a culture of sustained questioning that ideally should reside at the heart of any learning environment or endeavour.

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