# Empathy as an Aspect of Critical Thought and Action in Design and Technology

**Bill Nicholl**

**Abstract** User-centred approaches to design stress the importance of the designer understanding the needs and experiences of the user when designing products (Sanders E, Dandavate U, Designing for experiencing: new tools. In Overbeeke CJ, Hekkert P, (eds) Proceedings of the first international conference on design and emotion, 3–5 November 1999, Delft University of Technology, Delft, pp 87–92, 1999). How designers and others involved in designing have understood these needs has evolved since Taylor's seminal work in the early 1900s. One emerging and influential user-centred approach to design over the last decade has been inclusive design. Researchers working in this field have developed ways of working or 'signature pedagogies' that allow them to think critically and empathise with users, to understand their needs from their perspective and to use this understanding to critically inform their own actions when designing, as well as educating others in the practices of inclusive design. I will discuss these signature pedagogies, arguing that they are crucial for developing critical thinking dispositions and engendering empathy when designing and educating others. I will then discuss how the signature pedagogies of inclusive design were successfully introduced into high schools in a number of countries.

**Keywords** Empathy • Critical thinking • User-centred design • Signature pedagogies • Designing Our Tomorrow (DOT)

## 1 Introduction

Formal approaches to meeting the needs of users as part of the processes of designing have been around for over a hundred years with Taylor's methodological approaches to understanding how people worked to improve efficiency (see Baumgart and Neuhausre 2009) and Henry Dreyfuss' pioneering work (Dreyfuss 1955) on anthropometrics in the design of household products being two early

B. Nicholl (✉)
University of Cambridge, Cambridge, UK
e-mail: ban22@cam.ac.uk

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examples. User-centred approaches have stressed the importance of the designer understanding the needs and experiences of the user when designing products (Sanders and Dandavate 1999). How designers and others involved in designing have understood these needs has evolved since Taylor's seminal work. One emerging and influential user-centred approach to design over the last decade has been inclusive design. Researchers working in this field have developed ways of working or 'signature pedagogies' that allow them to think critically and empathise with users, to understand their needs from their perspective and to use this understanding to critically inform their own actions when designing, as well as educating others in the practices of inclusive design. I will discuss these signature pedagogies, arguing that they are crucial for developing critical thinking dispositions and engendering empathy when designing and educating others. I will then discuss how the signature pedagogies of inclusive design were successfully introduced into high schools in a number of countries. First however, I will discuss the relationship between empathy, critical thinking and design.

## 2 Conceptualising Empathy

Empathy is a relatively recent construct that has its roots in philosophy and psychology. The origins of empathy as a construct can be traced back to 1873 when Visher used the term 'Einfühlung' which is German for 'feeling into' (Hickman 2013). Later, Titchener adopted the same word, Einfühlung, but used it to align with notions from aesthetics and defined its meaning as being 'to project yourself into what you observe' (Baron-Cohen and Wheelwright 2004, citing Tichener 1909, p. xx). More recently, 'empathy has been termed an ability, an attitude, a feeling, an interpersonal process, a trait, a state, a sensitivity, and a perceptiveness' (Sutherland 1993, p. 309). Kunyk and Olsen analysed the concept of empathy and found five different uses of the term, namely, empathy as human trait, empathy as a professional state, empathy as a communication process, empathy as caring and empathy as a special relationship (Kunyk and Olson 2001). This, they conclude, suggests that empathy as a construct has not yet fully matured.

The philosopher Maxine Greene suggests that empathy is 'the capacity to see through other's eyes, to grasp the world as it looks and sounds and feels from the vantage point of another' (Green 2001, p. 102). Conceptualisations of empathy from the philosophical literature are congruent with the psychological literature. Although acknowledging empathy as being multidirectional, there seems to be a consensus among psychologists that empathy has two broad strands, namely, emotion and cognition (Lawrence et al. 2004). The emotional strand of empathy refers to 'an emotional response to . . . emotional responses of others' (Lawrence et al. 2004, p. 911). Emotional empathy has also been labelled 'affective' empathy where the emphasis is on the 'appropriateness of the viewer's emotional response' (Baron-Cohen and Wheelwright 2004, p. 164). Affective empathetic responses can

be further classified as 'parallel', for example, 'feeling fear at another's fright' or reactive responses, which go beyond mirroring the observed state and include a feeling of sympathy or compassion (Lawrence et al. 2004, p. 911 citing Davis 1994). In this view, sympathy is seen as a component of affective empathy (Baron-Cohen and Wheelwright 2004).

The cognitive strand of empathy refers to 'the intellectual/imaginative apprehension of another's mental state' (Lawrence et al. 2004, p. 911) and emphasises the observer's 'understanding and/or predicting what someone else might think, feel, or do' (Baron-Cohen and Wheelwright 2004, p. 165). The emphasis here is on 'taking the role or perspective of another person' (Baron-Cohen and Wheelwright 2004) and is based on the cognitive processes of role-taking and perspective taking (see, e.g. Mead 1934; Piaget 1932). Although discussed separately, some writers suggest that both affective and cognitive components are strongly interrelated (Kouprie and Visser 2009, citing Damasio 1994). Rogers conceptualises empathy as a process where one enters the world of another where one must 'be sensitive, moment to moment, to the changing felt meanings which flow in this other person ... communicating your sensing of his/her world as you look with fresh and unfrightened eyes ... checking with him/her as to the accuracy of your sensings, and being guided by the responses you receive ... you help the person ... move forward in the experiencing' (Rogers 1975, p. 4). Both affective and cognitive aspects of empathy, as well as empathy as a process, are important in design, and this will be discussed in due course. I would now like to turn to discuss empathy and critical thinking.

## 3 Empathy and Critical Thinking

In this section I draw on, and extend, the discussion presented by Williams in chapter "Critique as a Disposition". In particular, I would like to extend his discussion to explore the dispositional dimension to critical thinking in relation to the current discussion on empathy. Ennis defines critical thinking as 'reasonable reflective thinking focused on deciding what to believe or do. The emphasis is on reasonableness, reflection, and the process of making decisions' (Ennis 1996, p. 166). Halpern too stresses critical thinking as a process which requires one to be reflective, show sensitivity to the particular context one is working in, and be able to monitor one's progress throughout the process, involving 'judgement, analysis, and synthesis' necessary for solving ill-defined problems (Halpern 1998, p. 451). Monitoring and reflecting on one's own actions throughout this process is known as metacognition (Flavell 1987) and is characteristic of the dispositional dimension to critical thinking cited in the literature (e.g. Perkins et al. 1993). Each of these definitions describes critical thinking as a process which is summarised by Scriven and Paul:

> intellectually disciplined *process* of actively and skilfully realising, conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action. (Scriven and Paul 2003, emphasis in italics added)

Furthermore, each of these authors also stresses critical thinking as being a disposition. Katz (1993) defines dispositions 'as patterns of behaviour that are exhibited frequently and intentionally in the absence of coercion, thus representing habits of mind' (Williams citing Katz, chapter "Critique as a Disposition"). Williams suggests that dispositions have two components, namely, ability and inclination. An inclination is a person's tendency towards a certain behaviour, and ability refers to the capability to engage with the disposition. I shall return to critical thinking as a process later; for now however I would like to make the link between critical thinking and empathy. One of the thinking dispositions characterised by Costa and Kallick (2000) makes explicit reference to empathy, namely, 'listening to others with understanding and empathy' (Costa and Kallick 2000, p. 4). Empathy is clearly evident in the work of Ennis (1996) who has identified three broad critical thinking dispositions, one of which is 'to care about the dignity and worth of every person' which includes the dispositions to 'discover and listen to others' views and reasons; take into account others' feelings and level of understanding; be concerned about others' (Ennis 1996, 171–172). Finally, the disposition to be 'open-minded', which is commonly cited in the critical thinking literature (e.g. Perkins et al. 1993; Halpern 1998), would suggest that it is important to listen to, and understand what someone else might be thinking, how they might be feeling or what they might do in certain situations. This is particularly important when the 'observer' is different to the person being observed, in terms of their age or gender, religious or political beliefs or social background. Empathy, or being empathic, is therefore an essential part of what Williams refers to as the critical spirit, which he describes as 'a set of attitudes that define a personal disposition to prize and to use critical thinking in one's personal, professional and civic affairs' (Williams chapter "Critique as a Disposition"). The set of attitudes that contribute to an overall disposition to use critical thinking to form judgements are truthseeking, open-mindedness, analyticity, systematicity, confidence in reasoning, inquisitiveness and maturity of judgement (Williams chapter "Critique as a Disposition"). Conceptualised in this way, empathy is embodied within an overall disposition to think critically. In other words, being empathic is essential to critical thinking, and this will be discussed further in relation to design.

## 4 Empathy, Critical Thinking and User-Centred Design

At about the same time, as psychologists and philosophers were debating and honing their conceptualisations of empathy, researchers working in the field of user-centred design began to critique their own practices, and this revealed a number of

interesting findings. For example, some researchers realised the tools traditionally used to investigate users, such as questionnaires, were inadequate in 'creating a rich, empathetic understanding of the users' desired experiences' (Battarbee and Koskinen 2005, p. 6). Other research found that designers 'designed for themselves', and this is due, in part, to limitations of time, budget and logistical requirements faced by designers when solving problems (Cardoso and Clarkson 2012, p. 1; Coleman et al. 2003). Whether designers designed for themselves or used tools that were inadequate for engendering empathy, the result was often products that were difficult, frustrating or even dangerous to use (Porter and Porter 1999). Findings such as these raised serious questions about whether designers had the *ability* or the *inclination*, that is, had the disposition to think critically and, in particular, to emphasise with people outside their own empathic horizons when designing (McGinley and Dong 2011; McDonagh-Philp and Denton 1999). The interest in the role of empathy within user-centred design led to the term 'empathic design' in the late 1990s (Koskinen et al. 2003). This is where 'designers attempt to get closer to the lives and experiences of (putative, potential or future) users, in order to increase the likelihood that the product or service designed meets user's needs' (Kouprie and Visser 2009, pp. 437–438). A number of research projects investigated the designer's engagement in critical thinking and in becoming 'more sensitive to users, be able to understand them, their situation, and feelings: to be more empathic' (Kouprie and Visser 2009, p. 438). In order to get closer to the lives and experiences of users, understanding their situation as well as their feelings requires an empathic approach to design which is part of an overall disposition to think critically. Designers working in the emerging field of inclusive design have developed such an approach, which addresses the issues of a global ageing population. Empathy as an aspect of critical thought and action within the field of inclusive design is illustrated in work they have published recently. Visual ability is crucial when using products, for example, reading signs in public places and recognising icons. They found that the data readily available on visual abilities focused on a narrow set of measures. If these data were used to guide the actions of designers, they could potentially exclude a large proportion of the population. They conducted a survey examining a wider range of human capabilities and characteristics, including ones on vision. One of the recommendations resulting from this study was that text size needs to be 17–18 % larger for 'comfortable viewing' and meet the needs of a wider range of users (Goodman-Deane et al. 2016, p. 150). This illustrates how empathy as an aspect of critical thinking can guide designer's actions, and this will be discussed further.

The importance of user-centred approaches has grown in line with dramatic demographic changes. For example, it is estimated that 2 billion people will be over 60 in 2050, compared with only 200 million in 1950. The implications of an ageing population range from threatening the solvency of social security systems (pensions and public health) around the world (United Nations 2009) to products that are difficult, frustrating or dangerous to use. Research has shown that the people most likely to be affected by products that are difficult or frustrating to use are

those who suffer from some form of capability loss, especially those associated with, although not exclusive to, the effects of ageing, such as depreciating vision or limited dexterity in one's hands due to conditions such as arthritis (Keates and Clarkson 2003). User-centred approaches to design, and in particular inclusive design, have a key role to play in helping us to understand and address the problems faced by people with capability loss who can be excluded from using products and services safely and with dignity. At the heart of inclusive design is the need for the designer to think critically and be disposed to see things from the perspective of the user, to understand what someone else might be thinking, how they might be feeling or what they might do in a certain situation. Empathy or being empathic, as part of an overall disposition to think critically, is central to that understanding (Kouprie and Visser 2009).

Researchers and practising designers working in the field of inclusive design have developed a way of working that embodies this critical spirit, which comprises four interrelated 'principles': explore, create, evaluate and manage. This is called the 'design wheel' or process they use which is represented graphically below (see Fig. 1). The inclusive design wheel and principles serve two purposes, one of which I would like to discuss now and the other later. Firstly, inclusive designers use the wheel and principles to guide their critical thought and actions when they are solving design problems commercially, that is, to say, in the real world. There are many similar representations of design described in the design literature, and Cross suggests they comprise three core elements, namely, 'analysis, synthesis and evaluation' (Cross 2011, p. 27). Furthermore, these conceptualisations of design emphasise the iterative nature of designing, which requires the designer to monitor and reflect on his/her thinking when attempting to solve complex, ill-defined problems (Lawson 2001; Schon 1983). These conceptualisations describing design as an iterative process use a similar language to the psychologists and philosophers working in the field of critical thinking discussed previously. The critical thinking dispositions and how they relate to empathy, using the work of Kouprie and Visser (2009) and the inclusive design principles, are summarised in Fig. 1.

I would now like to discuss in a little more detail some of the empathic tools that have been developed to guide designers' thoughts and actions. Hosking et al. (2015) suggest there are two broad types of empathy tools: direct and indirect. Direct contact is where the designer explores by engaging first-hand with potential users via techniques such as observing users in their own context and user focus groups, where designers talk with end users early in the design process. Focus groups can also be used to generate ideas (create) or to feedback (evaluate) on ideas and prototypes that have been developed as part of an empathic, critical and iterative approach to design (Kouprie and Visser 2009; Dong et al. 2009). Indirect contact techniques are used when direct contact is not possible and serve the same purpose. Indirect techniques include simulation or role-playing techniques including 'product handling', 'experience prototyping', 'bodystorming' and 'informance' (Buchanau and Fulton-Suri 2000). Of particular interest here are simulation tools such as

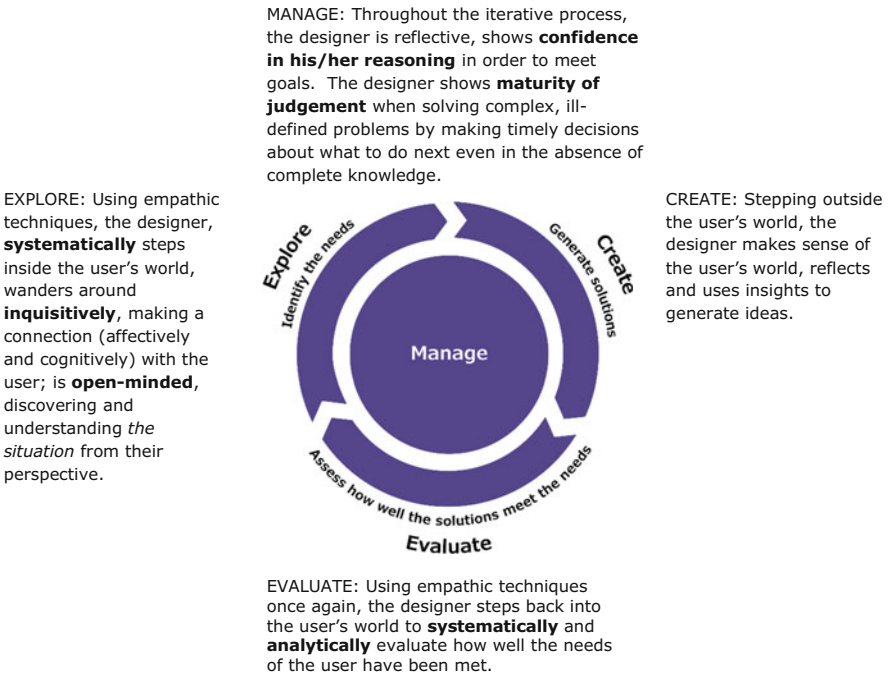


**Fig. 1** Elaboration of inclusive design wheel showing relationship with critical thinking dispositions (Design wheel © University of Cambridge)

**Fig. 2** Student (11 years old) using simulation gloves and glasses to role-play an older person with capability loss

glasses that simulate how one's vision depreciates with age and gloves which simulate the effects of arthritis (see Fig. 2). Simulation tools enable the designer to experience some of the effects of capability loss as they allow the designer to 'step into parts of the user's experience by simulating the user's condition' (Kouprie and

Visser 2009, p. 440). This perspective taking, via role-play, allows the designer to 'identify and evaluate the nature (the kind of capability) and magnitude (the level of capability) of the capability demands imposed upon the user ... it is necessary to be able to assess the features of the product to identify those that present difficulties to the user and, ideally why they present difficulty' (Keates and Clarkson 2003, p. 109). Consequently, simulation tools foster critical thinking when solving problems in a particular situation. This critical exploration phase can then be used to inform idea generation (create phase), and these ideas can be evaluated, critically, using the simulation tools, to see if the needs of users identified as part of the explore phase have been met. Managing what to do next requires the designer to reflect on and monitor his/her 'thinking' throughout multiple iterations when solving ill-defined problems (metacognition discussed previously).

Another indirect technique is task analysis. In a scenario-based task analysis, the designer 'imagines' they are someone else, such as someone suffering capability loss, undertaking a task, for example, preparing the table for a family meal. The designer would identify, systematically, each of the steps it takes to gather cutlery and layout the table in preparation for a meal. This systematic approach would then be used analytically, to identify and assess the demands each step places on the user, for example, picking up a knife from the table can be demanding for users who suffer from arthritis as it requires a pinch grip. Task analysis then requires the designer to be systematic, analytical, open-minded and truthseeking, all of which are attitudes that capture the critical spirit. Thinking critically in this way opens up opportunities to be creative as the designer can generate ideas (create) by focusing on reducing the demands for this task step, for example, generating ideas for a knife so that it is easier to grip/pick up.These ideas are systematically evaluated, and providing the demands in other steps has not increased; the new concept for a knife is more inclusively designed. Designers/researchers working in the field are referring to the process of empathy embodied throughout the process of designing (Kouprie and Visser 2009). The inclusive designer steps into the user's life in order to connect with them, both cognitively and affectively, in order to get a critical and 'deep understanding' of their life, and steps out of the user's life, in order to take on the 'role of the designer and makes sense of the user's world ... to reflect [and] deploy the new insights for ideation' which are then evaluated (Kouprie and Visser 2009, pp. 444–445). Consequently, empathy at the heart of a critical thinking process can lead to new insights which can lead to more creative solutions (McDonagh and Thomas 2011).

The disposition to think critically, with a particular emphasis on empathy, and how this might motivate students (12–15 years) and lead to creative solutions was explored in high schools in England (2010/2011), Ireland (2012) and India (2015). This work is discussed next.

## 5 Empathy as Critical Thought and Action in High School Design and Technology

In discussing empathy as part of critical thinking in high schools brings me back to the purpose of the design principles mentioned earlier. The second purpose of the process and associated principles is to educate graduate and experienced designers into the practices of inclusive design. Budding inclusive designers are introduced to the simulation tools and use them by interacting with product outcomes they have recently designed. This early immersion in the use of simulation tools gets the designers to reflect, critically, on these outcomes, and how large parts of the population have been excluded. The principles and tools are then introduced, via the design wheel, and the designers reflect, critically, on the design processes they went through when designing their product. This critical reflection is then used to guide the actions of budding inclusive designers. In order to do this, a problem they are currently working on is used, with the hope that they go through a critical, empathic, iterative process that can lead to producing more inclusively designed products. In this way, the wheel and associated empathy tools and techniques became the 'signature pedagogies', and this is important as they can shape how professionals behave as Shulman states:

> Signature pedagogies make a difference. They form habits of the mind, habits of the heart and habits of the hand. As Eriksson observed in the context of nurseries, signature pedagogies prefigure the culture of professional work and provide the early socialisation into the practices and values of the field. Whether in a lecture hall or lab, in a design studio or clinical setting, the way we teach will shape how professionals behave .... (Shulman 2005, p. 59)

This approach is aligned with sociocultural theories of learning that places an emphasis on 'contexts and social practices - and sees these as important "cultural resources" that are available to the learner from that setting' (Pollard 2002, p. 148). The interdependence between social and individual processes in the co-construction of knowledge can be traced back to the work of Vygotsky and has given rise to a number of interptretations including the situated cognition approach by Lave and Wenger (1991) and cognitive apprenticeships by Brown et al. (1989). Furthermore, contextualising learning experiences, and by implication teaching practices (principles and tools discussed here), within meaningful, real-world problems and practices, that is, the work of designers, has a long tradition and is consistent with the philosophical approach of Dewey who advocated 'meaningful school activity that extends experiences and practices of the adult world' (Dewey 1938, p. 3).

Using these signature pedagogies and real-life design problems as part of socialising designers into the practices of inclusive design is something we have investigated with high school students. Students had to find a design problem, based around a context, namely, 'dining', and were introduced to the simulation tools and guided through the design wheel and principles over a period of 12 1-h lessons. We were also mindful, however, that educating practicing or graduate designers is different to educating novice designers in high schools. For this reason, the signature


**Fig. 3** Task analysis sort exercise

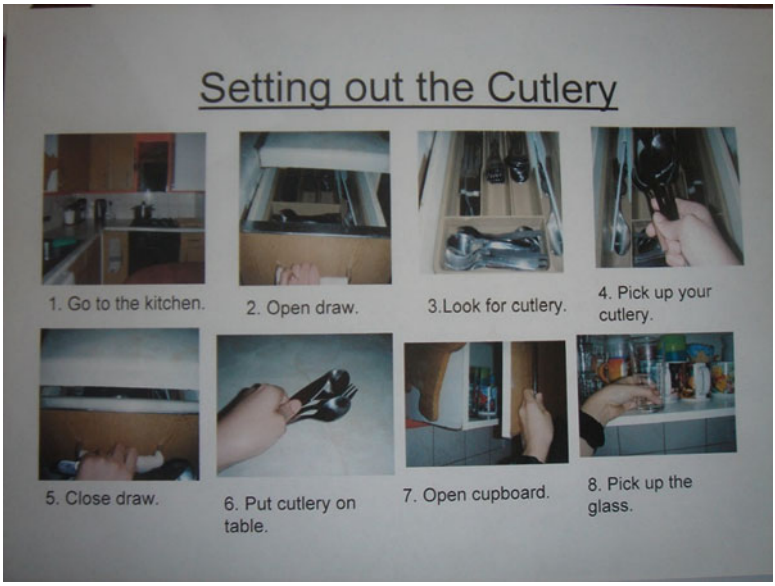


**Fig. 4** Example of a student's task step analysis showing task steps for preparing a meal (This page shows 8 steps of the 24 task steps identified (female 12 years))

pedagogies described above were complimented with other tools and strategies to guide and scaffold students' thinking and actions in solving the problem we gave them. This included showing them how to analyse problems, modelling examples of good practice (Wood et al. 1976). For example, in order to teach task analysis, we modelled how to do this via a card sort exercise. In groups of four, students were asked to sort the steps for a task not related to dining (see Fig. 3). Students could then do a task analysis for the problem they were working on, dining (see an example in Fig. 4). This is an example of task-related scaffolding, which is crucial

for maintaining the ambiguity of ill-defined problems like design problems, without reducing the task to a series of 'closed' steps or procedures to follow (Galton 2007). Other activities were varied, and many involved students working in groups, taking a dialogic approach to teaching and learning (Alexander 2008). Consequently, the signature pedagogies of inclusive design discussed earlier were important in establishing an environmental context where a culture of critical thinking could be fostered. The culture of critical thinking was further enhanced by strategies that helped students develop strategies of analysis. Further strategies will be discussed as part of the findings.

In terms of framing the research, in each country, we interviewed and surveyed students about their recent experiences in design and technology (D&T) prior to introducing the Designing Our Tomorrow (DOT) activity. We interviewed and surveyed the students again at the end of the project. Some of this work has been published (Nicholl et al. 2013, 2014). What follows are extracts from the student interview data, thematically analysed around three broad themes: students' reflections about the empathic activity, their motivations associated with this and their perceptions on how the empathic approach relates to their own creativity, in particular their generation of ideas. This was supported with survey data and field notes including examples of students' work and lesson observations. The findings, with some discussion, are presented next.

Given that students did not have any experiences of designing for other people prior to DOT (see Nicholl et al. 2013), students were able to appreciate the importance of seeing things from other people's perspective when designing, someone who was different to them as this excerpt reveals:

> If you want to make a product for them you've got to know how they use things and how they think, because they're different to us, we're not elderly people. So we have different things that we like and stuff, and how we react. (Female/13 years/England)

Furthermore, perspective taking and physically experiencing the simulation tools were commented on by students as being important in fostering and feeling empathy as these excerpts reveal:

> I think it's helpful to design for other people, because you kind of feel what their everyday life is like. With old people, like we had to use a finger restrictor, how … how they kind of like move their fingers is tough for them. (Male/13 years/England)

> If you look at it from a person of visual impairment and arthritis it really is difficult 'cos you actually get to simulate how tricky like simple things are like even just making cup of tea which I am sure pretty much all of you like and want to do at some point during the day and even the simple things like that … or putting salt onto your dinner it's just interesting to see and put yourself in that situation rather than putting it from a perspective … you actually get to do and experience. (Female/14 years/England)

> But the thing is, you've actually learnt what it's like to be visually impaired and how it would be like to not be able to pick something up and how frustrating it would be. (Male/12 years/England)

The importance of the simulators in facilitating the development of empathy, both affective (feeling) and cognitive understanding of users' needs, was understood by students. for example, 96 % of students strongly agreed/agreed, with the item 'Using special finger restrictors/glasses to change how easy it is to move my hands and to see really helped me understand people' s (e.g. elderly people and young children and people with poor eyesight) differing abilities'. The level of empathy exhibited by many students was exceptional. The following excerpt is used to illustrate this point. This 14-year-old girl was asked if the simulation tools helped her understand the problems faced by older people:

> yeah massively … 'cos like erm we had … we had little medicine pots and we thought you know ... you put your glasses on you know … but you really, really can't and like tube maps … I could no way could I find … and especially if you have never seen a tube map before ..erm which you didn't quite understand before you would say "oh yeah, you might not be able to see it very well" but you didn't understand the depth of it ..and especially with arthritis … it is so much harder than you think just little things like when you think shaking a salt pot … that's simple, but it's not, there's things like taking it out and putting new salt in it, which you didn't realise was so hard, without using the gloves you wouldn't understand. (Female/14 years/England)

In the excerpt above, a 14-year-old girl clearly understands that having no previous experience of using a product, in this case an underground map, would make that product more visually demanding to use than if one was familiar with the map prior to one's vision declining with age. This illustrates a high level of understanding of capability loss in relation to prior knowledge, as this can make a product easier to use. Furthermore, in terms of dexterity, this girl also understood that the most demanding step in using a salt shaker was not necessarily picking the salt shaker up and dosing one's food, but in actually refilling the shaker when it becomes empty, which is particularly demanding in dexterous terms as it requires a 'pinch' grip in order to remove the cap. This can be very difficult for a person who suffers from arthritis. This shows a very sophisticated level of critical insight with respect to systematically 'imagining' the steps and locating where the peak demands might be for a person with capability loss. In turn, this leads to the design problem being reformulated which maximises opportunities to generate ideas that are judged creative, as novel starting points can lead to more innovative solutions (Getzels and Csikszentmihalyi 1976). In another example, a student identified 24 task steps a person has to go through in order to layout the cutlery on a table for a family dinner. This sequence of 24 steps was systematically captured on her smart phone (see Fig. 4). The examples discussed here illustrate that perspective taking, if done systematically and analytically, can lead to critical insights. Students told us that experiencing empathic design tools and techniques challenged students' assumptions about the nature of everyday products such as using cutlery as these excerpts reveal:

> if the first thing you asked me was how many people in the world can use cutlery? I'd say everybody could, but then kind of like if you look at that it kind of puts it into proportion, and shows you. (Male/15 years/Ireland)

> then you kind of get into it, so you know a little bit about it [an aging person]. And you kind of say, oh, I didn't think that many people had this problem or whatever. And then you kind of have that set in your head for the rest of it, for the rest of the project. (Male/15 years/Ireland)

Challenging one's own assumptions was a strategy we introduced as part of the cultural activity and is another important constituent of critical thinking as one must be open-minded and flexible. Furthermore, challenging one's own assumptions is crucial for creativity (Csikszentmihalyi 1999). Having experienced what it is like being an ageing person, the student is able to understand their feelings and understand the implications this has when they interact with the made world; students were required to generate ideas using creative thinking strategies informed by the literature (Ward et al. 1997; Cross 1997; Nicholl et al. 2008). We asked students whether the empathy tools and creative strategies they experienced helped them with generating creative ideas. Students told us that the empathy tools helped inform their ideas as this excerpt reveals:

> Our designs were a lot better because of it ... because we wouldn't ... have maybe thought the things we did if we hadn't understood how they quite felt and how simple it was like even if was like a touch or a grip thing ... we were saying oh it's light we can do it ... but it's hard but we made our designs so much better from using it [empathy tools]. (Female/14 years/England)

> We were very creative. I never knew that it was inside me. ... and I want it to be like that every day. (Female/15 years/India)

This was supported by items in the questionnaire. For example, 96 % of students strongly agreed/agreed with the item 'My understanding of people's (e.g. elderly people and young children and people with poor eyesight) various abilities helped me come up with my design ideas'.

We wanted to get indications of how students embraced the DOT activity, which they found very engaging. A number of students stressed how much they valued being given the opportunity of tackling a real-life problem such as designing for an ageing population and how much they enjoyed using the empathic tools as these excerpts reveal:

> Well, I liked [the project] because we get to experience, like with the finger restrictors, experience what other people have with hand disabilities and stuff ... To how to like open a bottle or something like that. (Male/15 years/Ireland)

> We are not just making something for the sake of making it. Like it is going to apply to somebody in life ... It is not just something that the teacher wants us to do, like it is actually going to apply to somebody. And if it works, maybe we can take it a step further, and try and make someone's life easier. (Male/15 years/Ireland)

> Well, to design something that you have no experience with before, like everyday items that you deal with, maybe talking to older people, young parents or something to see what they use, so you might see before and get the chance to design it ... instead of just taking everything as your own, you know, consider other people in the design. (Male/15 years/Ireland).

Survey items on engagement supported the interview data, for example, 86 % of students in Ireland agreed that they liked 'having a real-life problem to solve', 89 % said they felt happiest when working on a project they felt ownership of and 100 % found the resources interesting and helpful. Making activities meaningful and relevant is crucial not only to motivation (Anderman and Maehr 1994) but also to developing critical thinking skills (Halpern 1998) and learning (McCormick 2004). Finally, we asked students about the empathic approach and whether this had any impact beyond the D&T classroom experiences. The following excerpt reveals how the DOT experience extended beyond the classroom:

> Thinking about other people that are disabled, and cutlery. And then you think that when you're having your tea and then you're cutting it up, and you're thinking that people can't actually do that. I'm quite lucky actually. (Female/12 years/England)

> Erm Well like. I went to my grandma's the other day and she was ... she's got arthritis and she wears glasses ... her vision isn't that bad but she is very arthritic and before I used to say ... "Ahh bless her" where know I ... I ... that is actually really hard like ... you just didn't quite understand that before but now, now seeing it you ... you really do feel for them and it did change it a lot. (Female/14 years/England)

It was both heartening and encouraging to see and hear students talking about the experience of DOT in contexts other than the classroom. Perhaps one of the most profound insights from all of our work to date came from an Indian student whose excerpt below summarises just how powerful and liberating teaching for dispositions within a D&T context can be:

> ... before this workshop we had chapters in our textbooks, and we would have to write essays about ageing, and looking after old people. Looking at like ... trying to think of what an old person feels like, what it is like to age, and to feel helpless. But I think that was just a little bit sympathy, and maybe pity. With what happened yesterday was empathising with them. Feeling the way they feel, and that ... that's not the same as looking at them from a different point of view, and looking at their problem. Feeling their problem is different from looking at their problem. And what we did yesterday really had a powerful effect. (Female/15 years/India)

## 6 Closing Thoughts

> The designer sets off to explore. To discover something new, rather than to reach somewhere already known, or to return with yet another example of the already familiar. (Cross 2011, p. 8)

Given the quote above by Cross about the role of the designer as well as the discussions on user-centred design outlined in this chapter, design and technology would seem to be well placed to foster critical thinking. As Paul asserts, 'Critical thinkers critique in order to redesign, remodel and make better', and this captures precisely what inclusive designers do (Paul 1995, p. 526). In their respective chapters, however, both Stables and Williams raise concerns about learners of D&T being set tasks that are formulaic, leading to learners' outcomes being identical

or with design being superficially addressed. Indeed, these features were typical of what we saw in our research prior to introducing inclusive design, where the focus was on the teacher teaching technical knowledge directly to students via activities that were procedural leading to practical outcomes that were identical (see Nicholl et al. 2013). This has major implications for the teaching of critical thinking dispositions as the 'image of the teaching and learning' is one where the teacher 'transmits knowledge and skills' and where the child listens to the adult (Pollard 2002, p. 152). Thinking dispositions cannot be taught directly in this way, but must be cultivated, indirectly:

> Dispositions are cultivated indirectly, not by transmission of knowledge but by a comprehensive culture of thinking that foster various ways of thinking dispositions. (Harpaz 2007, p. 1852, citing Passmore, 1967)

This is where the signature pedagogies of inclusive design are key. D&T student activities should be based on authentic and messy problems typically faced by designers, for example, the problems associated with capability loss and how this affects older people when eating. At the heart of the cultural activity is the iterative design process of explore, create, evaluate and manage (Hosking et al. 2010). This process becomes the 'organising pedagogical principle' that embodies the critical spirit, which is crucial for solving design problems (Lucas et al. 2014, p. 14). Direct and indirect empathy tools and, in particular, the use of role-play and perspective taking (Mead 1934) can be used iteratively and make up some of the 'signature pedagogies' that help 'form habits of the mind' as they 'provide the early socialisation into the practices and values of the field' (Shulman 2005, p. 59). McCormick citing the work of Schoenfeld in mathematics education agrees when he states that learning in D&T 'is not a matter of mastering a body of knowledge' but 'to understand the nature of these areas [e.g. design and technology] they [pupils] need to experience what it is like to engage in mathematical (or any other subject) activity' (McCormick 2004, p. 23).

This culture of thinking is more aligned with sociocultural theories of learning that place an emphasis on 'contexts and social practices-and sees these as important "cultural resources" that are available to the learner from that setting' (Pollard 2002, p. 148). Here the 'image of the child is active' and socially interacts with teachers and peers via 'challenges [that] can clarify thinking and extend meaningful understanding' (Pollard 2002, p. 152). The important role of the teacher in establishing a classroom environment in which 'a culture of critical thinking is fostered, expected and established' is stressed (Williams chapter "Critique as a Disposition"). The teacher is the ultimate cultural resource, mediating students through this ambiguous, ill-defined activity. Teaching for thinking dispositions, therefore, requires the teacher to 'embody in . . . personality and behaviour the disposition toward which he wishes to educate' (Harpaz 2007, p. 1852). This means a fundamental shift in current teaching practices, where the focus on the teaching of technical knowledge to the teaching of thinking dispositions in a way that can 'influence the values, dispositions, and characters of those who learn' (Shulman 2005, pp. 57–58).

The data presented here tells an optimistic story. Given appropriate learning experience(s) or cultivating activities, students can think critically, quickly develop feelings for and understand people beyond the characteristics of their own age group and broaden their own 'empathic horizon' (McDonagh-Philp and Denton 1999). Furthermore, they are willing and able to use this empathic understanding critically, exploring users' needs, identifying the demands products place on the user and generating solutions to meet the needs of an ageing population. In turn, this provides opportunities for students to think critically about their ideas, whether their ideas meet the needs of an ageing population. I am not suggesting that the students who participated in these studies will naturally choose this critical and empathic approach when designing problems. They have only had one experience of this type of cultivating activity. Williams reminds us, however, if students are consistently exposed to these types of learning experiences, then dispositions can be cultivated and developed into habits of mind. The findings discussed in this chapter should offer some encouragement to educators and teachers of D&T who value and want to develop empathy as part of critical thinking. Through them, their students have so much to gain, as Gallo states:

> Empathic role taking fosters imagination by providing opportunities for immersive, holistic, spontaneous, and novel responses to problems that are engaging and complex. In so doing, it exercises and nurtures intrinsic motivation for tasks requiring imagination, a tolerance for complexity and ambiguity, as well as self-esteem and courage. (Gallo 1982, p. 114).

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