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'Shaping Things': The impact of using design fiction as a pedagogical tool within technology and design education

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Abstract

*Inspired originally by the work of Bruce Sterling, this paper presents **narrative accounts from experienced design and technology teachers** who were introduced to the notion of "design fiction" during their teacher education programmes.*

While training to teach as part of their subject study, pre-service teachers were introduced to the concept of design fiction. During their training they were encouraged to embrace the notion and use it as a catalyst to effect innovative pedagogical approaches in their teaching of design and technology. Specifically, to explore the advantages of using this concept as a tool not only on the effectual delivery of design, but in order to support the creation of a high quality conceptual outcome, where learning is concerned with innovation and the development of skill, rather than to produce a fully functional working model or artefact.

Presented in the form of vignettes, participants (who are now experienced teachers) offer first-hand accounts of the long-term influence that using design fiction as a catalyst for teaching design and technology has had on their classroom practice.

Participants report how this approach has supported the consolidation of learning, reinforcing skills, knowledge and understanding. Findings also make clear that through the adoption of design fiction, teachers witnessed an increase in student motivation to engage in design activity, and notably when working within traditionally gender dominated areas of the design and technology and STEM curricula, gender bias decreased.

The paper concludes with potential next steps, including the advocation of staff development to ensure advances within the field of speculative design are capitalised upon by those engaged in all aspects of technology and design education.

Introduction

Inspired originally by the work of Bruce Sterling, this paper presents narrative accounts from experienced design and technology teachers who were introduced to the notion of design fiction while following their Undergraduate Design and Technology Initial Teacher Education (ITE) programme.

Participants completed their training (over three years) within a higher education institution in England between 2008 and 2012. Drawing directly upon pioneering work by Bell and Wooff (2012), Bell and Jones (2013), and informed by the findings of more recent studies (e.g., McLain et al., 2017) in presenting the participants' perceptions (of their lived experience), this paper seeks to illuminate the impact that using design fiction as a pedagogical tool has had. Not only on their practice, or in terms of the effectual delivery of design, but as a vehicle to support the creation of a high quality conceptual outcome, where learning is concerned with innovation and the development of skill, rather than to produce a fully functional working model or artefact.

As such, the focus of this research and hence the research question posed is:

What impact has the introduction of design fiction had upon the classroom practice of design and technology teachers?

The paper begins with a brief outline of the original work, followed by a definition of design fiction as perceived within the context of this paper. It then moves to examine the literature, outlines the research methods, including approaches to data analysis, before presenting the participants' perceptions.

Finally, the paper moves to explore developments in the field and concludes with potential future next steps, specifically suggestions for teacher education and continued professional development within the context of design and technology education.

Background

This study draws upon work undertaken with pre-service teachers between 2008 and 2012 who were studying for their Undergraduate Degree in Design and Technology Education. During the university-based element of their training, the pre-service teachers were introduced to the then nascent notion of design fiction.

Positioned predominantly within the context of future design within science fiction films, pre-service teachers were encouraged (through a series of university-based modules) to challenge their thinking around the use of the established term "science fiction" and embrace the concept of design fiction (de Vries, 2007).

At the time (a situation which sadly a decade on remains the same), as a subject, design and technology was under threat (Barlex, 2017; Irving-Bell et al., 2019). Physical resources were scarce, as was curriculum time, and pre-service (as well as in-service) teachers frequently expressed the challenges of engaging children in meaningful design activity, when all the children wanted to do was to make and "take-home" a product/artefact.

In response, to support their development as classroom practitioners, and in doing so combat the challenges faced in school, work undertaken during this period (of their teacher training) also sought to move pre-service teachers away from their own pre-conceived ideas about teaching design, which was supported by curriculum guidance at the time (The National Archives, DfES, 2004), and had become formulaic and was often delivered as a history lesson.

As such, approaches to session delivery were informed by the work of Trigwell (2002) and pivotal in that they actively sought to encourage the pre-service teachers to challenge their own conceptions of the subject, and within a framework of support to push themselves out of their comfort zones and to move beyond their own pre-conceived ideas of how design could or should be taught.

In addition to the media of film (including *Back to the Future*, *Total Recall* and *The 6th Day*) to support delivery, pre-service teachers were encouraged to read around the literature. Coupled with the introduction of concepts including *Cradle to Cradle: remaking the way we make things* (McDonough & Braungart, 2002) and *The Circular Economy* (Ellen Macarthur Foundation, 2011) and early iterations of design fiction as a tool to support the teaching of design (Stables, 1992), design fiction was introduced as a catalyst to stimulate innovative design for themselves, as well as to use with the children they were training to teach.

Defining design fiction: A review of the literature

Before moving to examine the literature within the field, it would be useful to present, within the context of this paper, the definition of design fiction used: "is a bit new and weird … and portrays a different kind of future than you might have been used to" (TBD Catalog, 2019, p. 1)

Since the term was coined in 2005 (Sterling, 2005), the notion of design fiction has been applied to and developed within numerous contexts, including artificial intelligence (AI), human-computer interaction (HCI) and the Internet of things (IoT), and since the publication of Bleecker's essay (2009) is now well established as part of the speculative design discipline.

Credited with coining the term speculative design, in their work, Dunne and Raby (2013) explore the notion of design fiction as a catalyst for social dreaming. They describe the use of design as a conceptual tool to critically explore the implications of new developments in science and technology and say that designers shouldn't just look to address the issues of today but must also look into the future and ask how future challenges can be addressed through design, stating: "When most people think of design, most believe it is about problem solving. There are other possibilities for design; one is to use design as a means of speculating how things could be" (Dunne & Raby, 2013, p. 2).

This is certainly true from the perspective of Tanenbaum (2014), and Markussen and Knutz (2013) who debate the term's definition, advocating the need to increase understanding around the use of design fiction as a research approach.

According to Sterling (2012), design fiction is the "deliberate use of diegetic prototypes to suspend disbelief about change" (p. 1). This echoes Lindley (2018a) who describes design fiction as concerned with the process of building a fictional realm, where future visions may be brought to life through the process of designing, modelling and prototyping. According to Lindley (2018b), while centrally held notions include a concern with the future, he contests that there is little consensus around the specifics of how each individual term (design and/or fiction) may be defined. As a result, the term has multiple meanings, each determined within and via the context of its use.

Design fiction as a design and technology pedagogy

Within the context of this research, as a notion, design fiction was introduced to pre-service teachers while Sterling's concept was relatively new, hence at the time its primary application was to explore innovative ways in which lecturers at university could inspire the pre-service teachers and encourage them to adopt "state-of-the-art" pedagogic delivery of design within their own practice.

As such, within this paper, design fiction aligns with the work as defined by Kirby (2010, 2011) whose study in the field of development of diegetic prototypes within the field of entertainment has focused upon the contributions made by "scientists" employed by film

makers, and the subsequent impact these future designs have had on science and technological developments in the real world.

Other studies in this field

Other than pioneering work by Bell and Wooff (2012), and Bell and Jones (2013), which documented how design fiction was being used within ITE to transform the education and training of design and technology teachers approaches to teaching design, there is limited work within the field specific to use of design fiction as a catalyst for design within design and technology education.

Prior to the coining of the phrase, based on the notion that design and technology is premised on a notion of what might be rather than what is, early work by Stables (1992) advocates the use of fantasy as a positive to support young children to engage in creative, designerly activity.

This is similar to later work by McLain et al. (2017) who explore the use of design fiction with primary age children. In this example, working within the context of traditional stories (which also supported links to the development of the children's literacy) the children were encouraged to speculate and use the notion of design fiction to help create a futuristic solution to solve a fictional design problem.

More recently adding to work in the field, Hardy (2018) illuminated the use of design fiction within design and technology education within a handful of local English schools, where the concept has been used to teach children about new and emerging technologies.

Methods

Theoretically underpinned by social constructivism, which aligns with the authors' individual epistemological and ontological positions, this study adopts a relativist paradigm, and we recognise the subjective experiences of multiple realities for the participants and ourselves in relation to social and technological activity (Guba, 1981, 1990). Adopting a collaborative approach, the co-construction of knowledge was encouraged through joint questioning and interpretation, which was further informed by samples of both the teacher's own and students' work, and through recall of the activity undertaken in the classroom (Bowen, 2009; Stake, 2005).

Documenting work undertaken by pre-service teachers who completed their undergraduate teacher education programmes between 2008 and 2012, data collection for this paper engaged a small number of those students (n=9) to examine for analysis the impact of this aspect of their teacher training has had on and in their practice. As such, this study's findings may be considered to fall within the field of practitioner inquiry (Baumfield et al., 2012), and the approach adopted was one informed by case study, which is a long-established method of documenting phenomena, across a range of disciplines (Merriam, 1998; Stake, 2005).

Prior to data collection for this paper, using electronic means of communication (i.e., social media/email) an open call for participants to engage in this research study was made to ex-students. In total, 38 potential participants responded. Of those expressing an interest, nine (n=9) participants were selected. This number was deliberately small to help ensure our ability to engage in meaningful interview conversations in order to gather rich and detailed narrative data. Participants were chosen at random, but within the following criteria:

- Each had to have been a pre-service teacher training to become a secondary age (children aged between 11 and 18 years old) design and technology teacher between 2008 and 2012 (ensuring they had completed/experienced the design fiction related modules).
- At the time of their engagement, they had to be employed within their respective institutions as a teacher of design and technology and had to be active in teaching design.

Prior to participation the aims and purpose of the study were explained to participants and informed consent obtained. Data collection took the form of a semi-structured interview, which was akin to a conversation with a purpose (Kvale & Brinkmann, 2009), with follow up email discourse occurring, if necessary, to clarify any specific detail. All data was encrypted/stored securely, and to mitigate the potential for bias, interviews took place in a neutral setting, at a time of mutual convenience, with an author who has not been the participant's tutor. All research was conducted in adherence to ethical guidance as outlined by the British Educational Research Association (BERA) (2018), and interviews were undertaken in accordance with procedures advocated by Bowden and Green (2005), recorded and transcribed verbatim, with participants being given the opportunity to check transcripts for accuracy in order to avoid misrepresentation.

Through interview conversations rich narratives emerged, and participants (who are now experienced teachers) gave first-hand accounts of the influence design fiction has had on their classroom practice. Recollections included participants' memories of their own degree work, where they were first encouraged to embrace the notion of design fiction within design and technology.

Retaining a clear focus on the research question (What impact has the introduction of design fiction had upon the classroom practice of design and technology teachers?), conversations explored how the use of design fiction as a catalyst to affect innovative pedagogical approaches had influenced their teaching, particularly their approaches to the delivery of design capability and innovation within the context of product design.

Following analysis of the data, which was conducted in accordance with procedures advocated by Braun and Clarke (2013) and Finch (1987), three vignettes were developed to present aspects of the findings as a whole.

Presentation of the study's findings

Build up from the data the vignettes present rich and detailed accounts of the participants' perceptions of their lived experiences (of using design fiction in the classroom). Specifically, how they used what they learnt (while training to teach) to support the effective delivery of design within design and technology, and the significance of the sustained impact that this approach has had as participants have progressed through professional practice.

For context, each vignette offers a brief outline of the participant's background (i.e., their position within their educational setting and material area) and, where appropriate, their perceptions on learning, personal development and related practice within their respective settings.

Vignette One

Now in her 12th year of service, Head of Department Traci continues to use design fiction not only in her own teaching but encourages her departmental staff to do the same. In this vignette Traci explains how she utilises design fiction daily within her own specialist subject area, technological textiles:

> *… I was captivated by the work at university, it wasn't so much the sci-fi films, but more when we explored how film has influenced design trends, particularly apparel textiles. My favourite has to be one of Alexandra McQueen's recent collections, the homage to* Blade Runner. *It makes you really stop and think, and question who is the designer?*

She went on to say

> *… building upon my previous experience (working within the textiles industry) and the development of Personal Protective Equipment (PPE), I'm particularly interested in STEM and the innovation application of new materials within technological textiles. I recall being shown a video interview with the designer of the police uniforms from the film* Robocop *and thinking wow! Based upon this, combined with materials such as Kevlar and D30 I use this as an example within my teaching all of the time.*

> *The beauty behind design fiction is that the children don't have to make a fully functioning working product and I have found that they can (and do) therefore focus more on the development of other skills, which include iterative design, the quality of finish or it gives them an opportunity to experiment and actually learn about the materials they could use, or thinking of the future materials that need to be designed!*

> *In designing products for the future, in my lessons we have explored PPE, wearable technologies (including integrated sound systems) and in one recent project, aware that Kevlar doesn't protect the wearer from a blade, one pupil*

has been designing new clothing to help address knife crime … and conscious of the engendered nature of textiles, an additional benefit that has resulted from work in this area has been a significant rise in the number of boys opting for the subject [beyond compulsory schooling].

With regard to the continuation of her own professional development Traci added,

I am fortunate to have been able to undertake a handful of design and technology focused training courses over the years, but these are few and far between now, so no I haven't updated myself in relation to design fiction/teaching design.

Vignette Two

Now in his 10th year of teaching, in this vignette Marc explains how he has been using design fiction as a mechanism not only to help pupils to become more engaged in designerly activity within his teaching (product design), but alludes to other benefits which include higher-quality pupil outcomes and the positive impact it has had on helping to combat a reduction in curriculum time, equipment and departmental resources:

… I find that the pupils always want to make things, which is great, but coupled with reduced curriculum time and shorter lessons, and the pressure of limited physical materials I am mindful that the quality of pupil outcomes may be reduced. Also, quite often, because they [the pupils] focus purely on the making they don't always learn a lot [as much as they could]. Sometimes I've struggled to get them to design but have found that by using design fiction I've been able to encourage them [the pupils] to really get actively involved in all sorts of design activity.

I've found it [design fiction] to be particularly valuable in product design, where thinking hasn't been restricted by the tools, equipment and materials they may have available to them. Working in this way I've been able to develop the pupils' drawing techniques but have also found using computer modelling and simulation invaluable. Then when we have gone on to make a prototype model, I have found the focus has been on working to support pupils to develop practical skills, such as cutting, shaping and forming the materials, and also I have found that this approach has given them more time to focus on getting a really high-quality finish on their work.

Working in this way also helps me to help them [pupils] to develop their visual communication and presentation skills. Overall, I have found the use of design fiction really helps to make the delivery of design lessons much more interesting. Sometimes I focus on big themes such as transport, environment and communication and have found that when considering the "human

aspects" of technology girls in particular become more interested in the work than perhaps they would have previously.

On the subject of professional development Marc said:

We don't have many, if any opportunities to attend subject specific staff development here, but I am a member of a couple of online subject related forums so use these to update myself/access knowledge and information, but no I haven't seen anything that would help me to update my knowledge of approaches to teaching design/design fiction, sorry.

Vignette Three

In this third and final vignette, Ryan, Head of Food Technology, and in his eighth year of teaching, explains how he uses the notion of design fiction within food technology:

At first, when we covered this at university, while useful for other material areas, I couldn't really envisage how I would be able to use the notion of design fiction within food technology. However, now I don't know how I could ever cover some of the content of our curriculum without it.

He continues:

… to be honest I didn't use it in my first few years of teaching because it didn't seem to fit with what I was doing. At university we had drawn heavily on film as a catalyst for the original work, which fell predominantly within product design, but then out of the blue the Hunger Games *was released. At the time it coincided with work my pupils were covering in English Literature around "dystopian" futures. So always trying to ensure that what I do in the curriculum meets the needs and interest of my learners, I decided to bring both ideas together.*

For example, drawing upon topics such as sustainability, GM and modified foods, food miles and food provenance, which as a food teacher are interesting to me, but are often perceived as being quite dull to the pupils. I found that by embracing the design fiction concept I was able to explore food in a completely different and new way.

He concludes:

… within the context of climate change and alternative futures I regularly use design fiction as a means of encouraging my pupils to explore what food could look like in the future and how, through technological innovations, food may change.

I've been able to revisit other potentially difficult aspects of my curriculum, for example food preservation, canning, hydration and freezing, and look at

hydrated foods which, bringing in science, allowed us as a class to look at possible food perseveration techniques for the future.

It is great because I've found that the children always come up with some wild and whacky ideas from food pills to shrinking and re-hydrating foods, but also to reduce food waste. Which more often than not leads back to conversations around the purpose of "food", another important area for debate. For example, is eating a function required merely for energy or as a source of nutrition? Or considering taste and texture, is it a sensory experience? Or thinking about preparing food for celebrations, is it a cultural and social event?

Either way I have found it [design fiction] to be an exciting way to stimulate some great debates! It certainly gets everyone thinking and helps us to cover so much of the curriculum in new and innovative ways!

Regarding his professional development:

I have completed several internal staff development courses, but these are generic to ensure I am complying with changes in legislation, such as safeguarding for example, so no I haven't completed any subject specific courses/training since I qualified to teach.

Summary of findings, discussion and implications

Analysis of the findings (presented here as vignettes) makes clear that participants (n=9) engaged in this study have found the sustained adoption of design fiction related activities within their teaching to be a useful tool to support the effective delivery of design within a range of design and technology educational subject disciplines.

Participants consistently cited a tangible increase in pupil/student motivation (irrespective of subject discipline) to engage in curriculum content they as teachers had previously found difficult to deliver in a way that pupils found to be interesting. In addition to stimulating active classroom discourse, participants also cited enhanced engagement in designerly activity, and noted genuine improvements in pupils' visual communication skills/techniques and the quality of finished work (where artefacts were produced).

Findings also highlighted another significant benefit. For those participants working within traditionally engendered areas of the curriculum (for example, technological textiles and product design) each noted the enthusiastic engagement of the non-dominant gender (male pupils in technological textiles and female pupils within product design) increased when pupils were engaged in tasks/activities originating from the concept of design fiction.

In summary, the adoption of design fiction within their teaching (professional practice) was perceived by participants (in this study) to be effective in facilitating pupils' fervent engagement with design thinking activities, and supportive in the development of their pupil's visual communication skills and techniques. It was also perceived to be an effective catalyst

to enhance stimulating and meaningful debate, increasing the active engagement of all pupils, which in turn enabled (where appropriate) the creation of high-quality, innovative outcomes and artefacts that transcended material areas.

Towards the end of each interview conversation, participants were asked about if (or how) they had been able to update their knowledge and understanding in this area. While participants recalled design fiction as a concept introduced to them at university, and articulated some opportunities to engage in school-focused continuous professional development (CPD), through conversation it was evident that while they had used the concept in numerous ways over the years, as a mechanism to stimulate design work within their own practice, the majority (7/9) hadn't updated their working knowledge of the concept/notion itself.

In the decade since completing their initial teacher education programmes, design fiction has become well established as a valid concept within the field of speculative design, and coupled with technological advances in both science and technology, work within the field has developed considerably. For example, within the context of speculative design (and design fiction) and the Internet of things (IoT) (Stead et al., 2019a) advocate an approach to sustainability, which is to build meta-history data into the design of products (Figure 1). Their work to develop *spimes*, the neologism used to define a futuristic object which can be tracked throughout its lifetime, as sustainable connected devices, is fascinating. Building upon work originated by Sterling (2005), the concept is that spime -like devices would generate their own meta-history data, and through the use and adaptation of other emergent technologies, such as blockchain (Figure 2), could be used by the conscious consumer to help to facilitate sustainable behaviour.
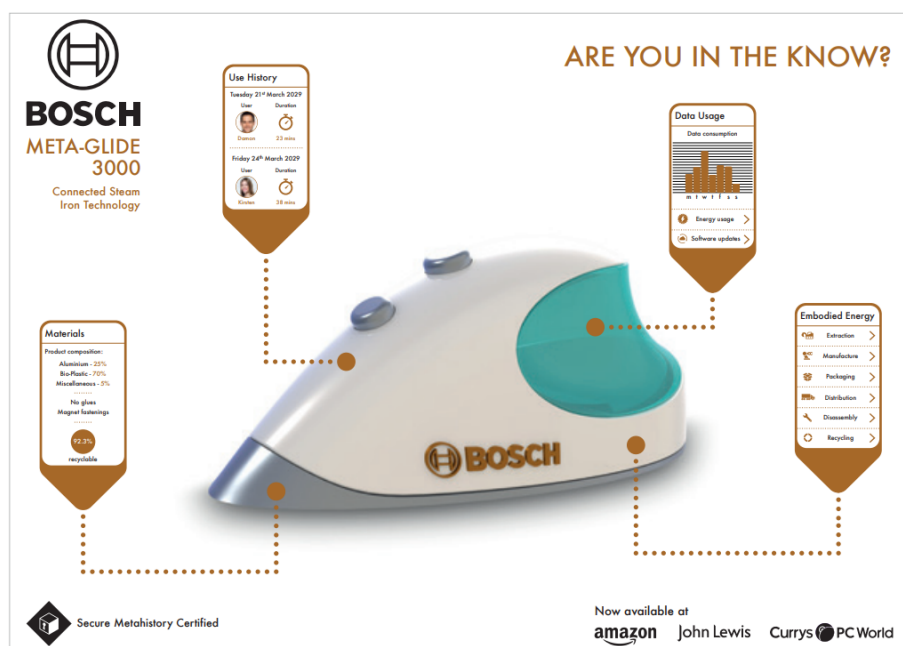

Figure 1.   Spime-like devices: Potential meta-history data generation. (Stead et al. 2019b)

For clarification, within the context of this paper blockchain is referred to as a record keeping system, used to describe how growing lists of digital information are stored. The easiest way to understand blockchain is to think of the digital information being stored as a block, and the way (or place) it is stored as the chain.
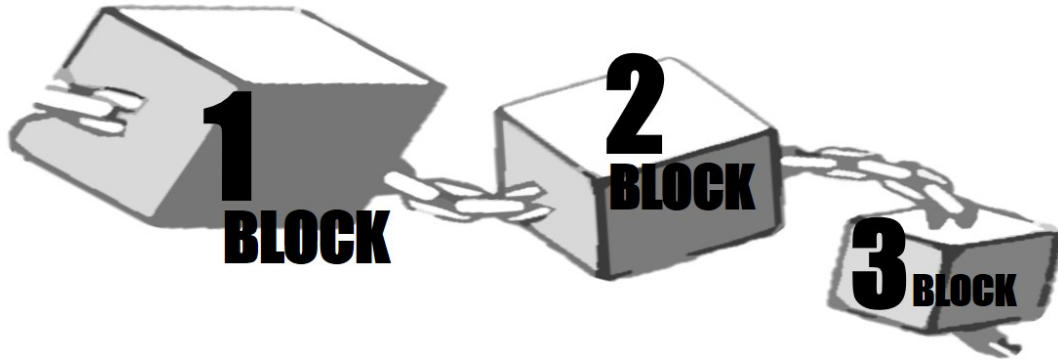

Figure 2. **Visualising the notion of blockchain.**

Within a broader context, as a term, blockchain is frequently used in conjunction with the digital cryptocurrency bitcoin and utilising financial transactions as an example to aid understanding of how blockchain works, when new information is added it is added as a new block, which makes it very difficult to change/manipulate any of the previous blocks (information) in the chain. Within design, the concept of blockchain could be used to support children to understand more fully the wider (global, social and moral) implications their design work may have.

Within the context of design and technology education, which within England remains a curriculum subject in severe decline (Irving-Bell et al., 2019), and bound within wider issues arising from global consumerism, the use of design fiction offers the potential to move away from the traditional focus on "designing and making". Embracing design fiction and speculative design could support not only the development of new ways that we think about design, but support changes in how we set about teaching designerly activity as part of work to consider a revised curriculum.

In a shift from previous curriculum, in England the subject's current content for the design and technology's General Certificate of Secondary Education (GCSE) would appear to be support of encouraging students to take more designerly approaches. Including "considering contemporary and potential future scenarios from different perspectives" (DfE, 2015). Hence a potential starting point to support teachers in making a managed change could be to revisit the subject's established pedagogical models of design (for examples please see Figure 3).

Considering the long-term effect that new technologies have within and upon society, one approach could be to replace these traditional models with visual representations that convey new ways of thinking. Models such as those illustrated in Figure 4, which if adopted could hold considerable potential to re-imagine design education in our schools.
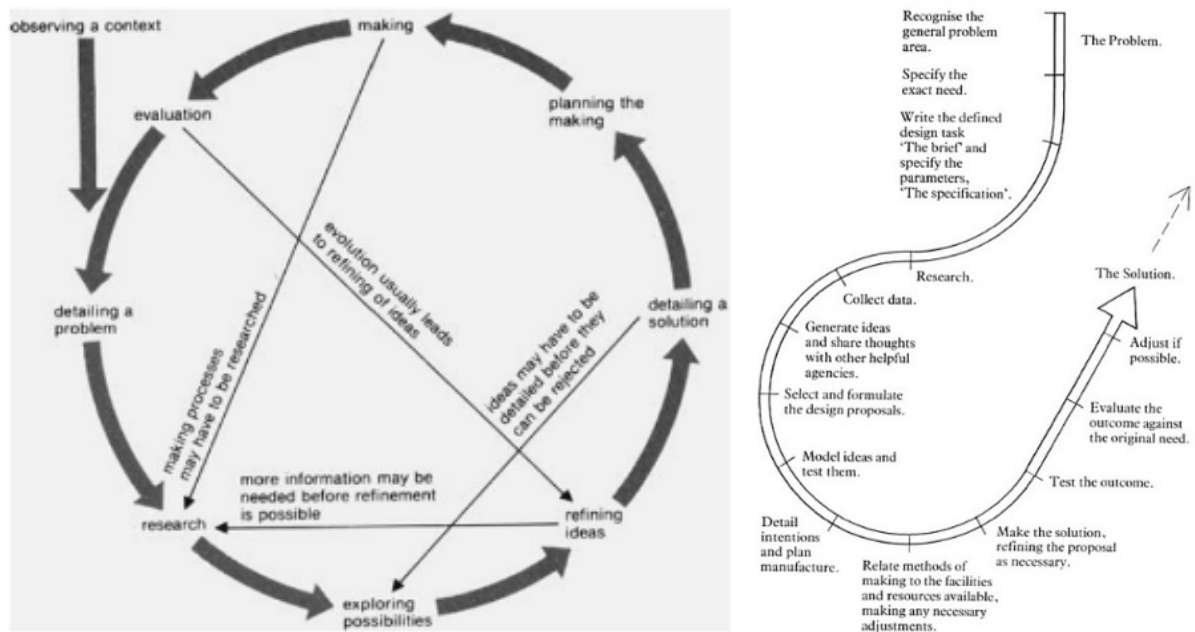
Figure 3. Traditional models used to describe the design process. (Adapted from Kimbell & Stables, 2007, p. 73)
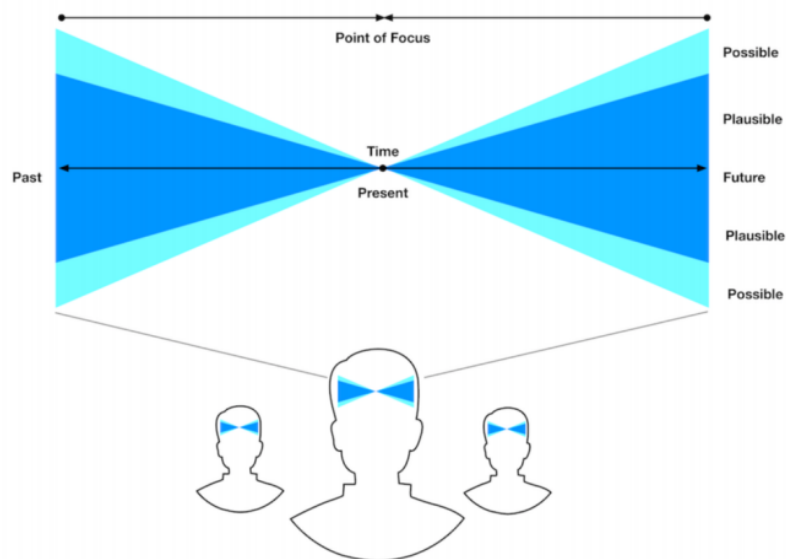

Figure 4. Modelling the future: A new design process? The hermeneutic model of the future (Lindley, 2018b, p. 156)

Concluding thoughts

Early work undertaken that pre-dates this study sought to embrace the then relatively new notion of design fiction. findings captured via participants' narratives make clear that it is a valuable platform from which to instigate and stimulate design debate. As previously noted, it is important to recognise that in the decade since undertaking the original work, design fiction has become well established within the field of speculative design, and work within this area has developed considerably.

As findings from this study make clear, while some participants have been afforded opportunities to update their general curriculum knowledge, the innovations and developments specific to this area, which could be advantageous to the study of design (and technology) in schools, appears not to have been successfully transferred (i.e., through teacher education or in-service programmes) into the classroom as perhaps they might.

Embracing new approaches to design thinking could be pivotal in supporting teachers and teacher educators of technology and design education to re-imagine the subject, and in doing so reflect positively upon its purpose and value within a modern school curriculum (Irving-Bell et al., 2019).

In moving this work forward, by way of next steps, we would advocate for consideration of ways in which teachers may be supported to access and develop resources which reflect current thinking within the field of (speculative) design. Particularly with regard to spimes and the use of new, transformative technologies, such as blockchain, to track and trace a new product's meta-history and asset transparency (Stead et al., 2019a).

Approaches that will help children not only to develop their understandings around the concept of responsible design, but to support them to be conscious of their choices as consumers.

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