The Epistemological Differences Between a Teacher and Researcher: A personal journey illustrating second order action research

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Abstract
This keynote address tells the personal journey of a former teacher who is now involved in educational research. Educational research is topical at the moment in Design and Technology (D&T) Education, as many initial teacher training (ITE) courses make the transition to masters level accreditation, something endorsed by the teacher training and development agency (TDA) as a means of enhancing the status of the teaching profession. The implication being that ITE courses will develop a significant research component to their courses. This paper argues against relying on experience only, or anecdotal accounts as a means for understanding or explaining the nature of the phenomena being studied. The case for conducting educational research that is 'systematically, sceptically and ethically' (Robson, 2002) conducted, is seen as a means understanding human behaviour, in a way that leads to conclusions that are credible (Cohen, 2007). The author draws on his experience as both a teacher in school, and as a Principal Investigator of a large, Gatsby funded research project, which looked at creativity in design and technology which is influencing policy and practice both nationally and internationally.

Key words
action research, creativity, interpretive, epistemology, verstehen

Rationale for this keynote

The focus of this keynote is discussing my transition from teacher to researcher, and illustrating this with a major research project I have been involved in for the past 3 years. Teacher as researcher is a topical issue within education generally and Design and Technology (D&T) education in particular. For example, many initial teacher training courses (ITE) in England are making the transition from Post Graduate Certificate of Education (PGCE) to Masters Level Accreditation, and by implication, teacher training courses like my own, have a significant research component. This is a move supported by the Training and Development Agency[1] (TDA) who see masters' level qualifications as a means of raising the status of the teaching profession. The Design and Technology Teachers' Association (D&TA) were interested for me to focus on this, at their International Annual Conference, because it is attended by many D&T teachers, both nationally and internationally.

Teacher as researcher

One of the key message from this keynote stresses a systematic and rigorous approach to research as a means of reflecting-on-action (Schon, 1987) and as such, stresses the importance of the teacher-as-researcher, a movement inspired by Stenhouse (1975). This movement has been associated with action research. Ebbutt (1985) regards action research as a systematic enquiry that combines action and reflection with the view to improving practice. Kemmis and McTaggert, (1992: 21) make a clear distinction between the systematic and rigorous approach of action research compared to the way everyday teachers think about their classroom practice. In summary, thinking about, and reflecting on one's own practice, in a systematic and rigorous way, with the view to improving practice, are important features of research I will return to throughout this keynote address. Thus my reflection on my personal journey therefore, can be said to have an empathy with action research methodology, improving my own research practice from when I was a teacher to now, as a researcher. I shall return to action research towards the end of this keynote.

I am aware that by focusing on aspects of research in this keynote address, I might be accused of treating research and research methods in a technical way. This is not my intention. My intention is to illustrate how my own thinking and practice have evolved from when I was a classroom teacher, in two inner London comprehensive schools, to that of a researcher, in charge of a major research project that investigated creativity in Design & Technology (D&T) at secondary level (11-16 years). In many ways, this journey is an epistemological journey. Epistemology 'is a way of understanding and explaining how we know what we know' (Crotty, 1998: 3). In other words, this journey highlights the epistemological assumptions I held as a teacher, to that of someone who is now involved in , and knows a lot more about, educational research.

In presenting my journey in this way, I am not trying to suggest that research is easy, or that this particular journey is the definitive construction of the social (or educational)

1 The Training and Development Agency for Schools (TDA) is the national agency and recognised sector body responsible for the training and development of the school workforce in England.

research process(es). Reflecting on my own journey, I hope to provide particular insights that might help fledgling D&T teacher researchers, and student teachers of D&T to realise how research can help them understand, and hopefully inform, their own teaching and ultimately student's learning in D&T. Thus, the important role of the teacher as researcher emerges. I also believe that teachers as researchers can only raise the status of D&T. Thus, the dual importance of research has been stated here, and endorsed recently by a colleague, John Dakers when he stated:-

'I am passionate about the importance and status of technology education and truly believe that its delivery must be informed and supported by research' (Dakers, 2008)

Educational research and theoretical perspectives

Although not central to my keynote, I hope the relevance of discussing theoretical perspectives and their underlying assumptions will become clear. This does present a challenge, as terms in the literature are often 'far from consistent' (Crotty, 1998:1) and terms can cover a wide range of paradigms (Evans, 2009: 113). I will do my best to be reasonably clear in my explanation in this section.

Cohen et al, (2007) suggests education research has 'absorbed' two competing views of the social sciences in order to 'discover 'truth', namely the 'traditional view' and the 'interpretative view' (Cohen et al, 2007: 21). These two theoretical perspectives represent 'different ways of looking at social reality and are constructed on different ways of interpreting it'(Cohen et al, 2007: 7)[2]. The approach we adopted in our research and one I wish to illustrate in this keynote are from the interpretative view. Thus, we are concerned with 'the subjective experience of the individual in the creation of the social world'. Evans suggests that educational research is concerned with the 'probing of phenomena such as people's beliefs, assumptions, underpinnings, opinions, actions, interactions or other potential sources of evidence of the processes of learning or teaching' (Evans, 2009:113). As one can appreciate, many of these phenomena involve human actions that are 'hidden'. In discussing Dilthey's work, Counsell says that human actions are 'bursting with meaning' and 'making sense of human action requires a special kind of understanding, and this is where interpretation comes in' (Counsell, 2009: 261). Thus, to understand social phenomena, social research has to get insights 'into the hidden meaning behind human action' (Baronov, 2004:119). The German historian Droysen (1808-1884), termed this special type of knowledge *verstehen* (understanding).

One's theoretical perspective cannot be separated from the epistemological assumptions that underpin it (Evans, 2009: 113). Researchers who hold the traditional view see knowledge as 'hard, objective and tangible' and will demand of the researcher an 'observers role, together with an allegiance to the natural sciences' and can be said to be positivist (Cohen et al, 2007:7). Interpretative researchers on the other hand reject this positive view of knowledge. They see 'knowledge as personal, subjective and unique' and acknowledge that this 'imposes on researchers an involvement with their subjects' and are said to be anti-positivist (Cohen et al, 2007: 7). Furthermore, to interpretative researchers, 'meaning is not discovered, but constructed' and '…different people may construct meaning in different ways, even in relation to the same phenomenon' (Crotty, 1998:9). Thus, interpretation has an emphasis on 'understanding of unique and the particular individual case rather than the general and the universal' (Cohen et al, 2007: 21, citing Burrell and Morgan, 1979, and Kirk and Miller, 1986). Given the emphasis on the individual creating, modifying and interpreting his/her world, the approach takes on a qualitative (such as observing lessons and interviews) as well as quantitative (such as tests or surveys) aspect (Cohen et al, 2007:8).

It is important to discuss theoretical and epistemology perspectives when studying human behaviour as they raise issues for research in classroom and schools. These perspectives influence 'The choice of the problem, the formulation of questions to be answered, the characteristics of pupils and teachers…the kinds of data sought and their mode of treatment…' (Cohen et al, 2007; 8-9) These are some of the things I wish to focus on in this keynote from now on, using my journey to help teachers understand how research in their own classrooms.

Where it all started

For me it started during my first year in teaching back in 1991. One of the first pupils I taught was a student called Angil. He gathered research from the Argos catalogue and used these images to inform his early design ideas of radios (figure 1). It soon became clear to me, that Angil was not the only student who found it incredibly difficult to generate creative ideas. In fact, I noticed that their ideas were very much influenced by what they had researched,

2 The author acknowledges that this is presented somewhat simplistically. For a more comprehensive introduction, see Wilson (2009) Cohen et al. (2007) or Crotty (1998). I suggest the novice researcher reads them in the order presented here.

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Figure 1. Work showing student design ideas based on research from the Argos catalogue (circa, 1992)

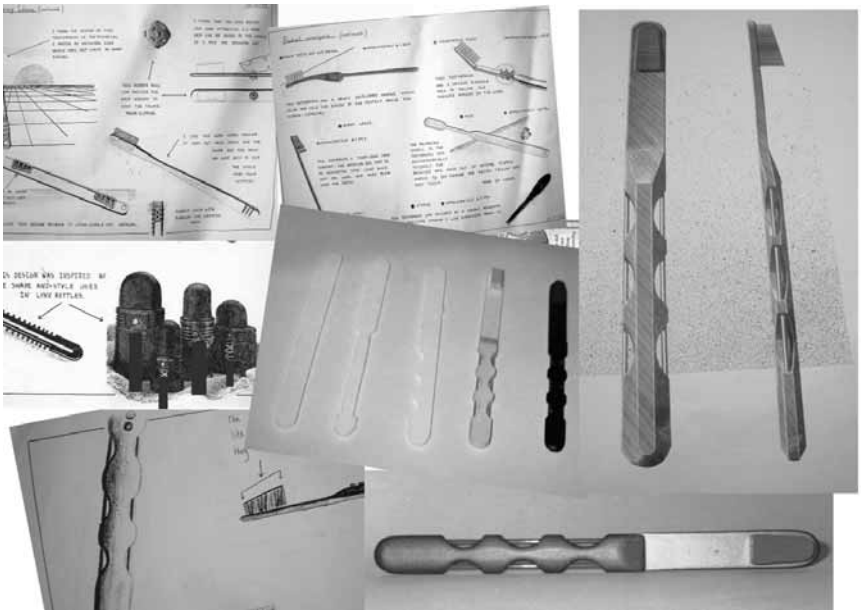

Figure 2. Using someone's lifestyle to develop toothbrush designs ideas (circa 1992)

which was often the Argos catalogue! During the next project I taught Angil, I tried to get him to think creatively, by using a strategy based on someone's lifestyle (figure 2). This strategy seemed to help Angil overcome some of the problems he encountered generating creative ideas for the radio project. As a new teacher this fascinated me, and has done so ever since. Design, and the teaching of creative design has become somewhat a passion, if not obsession of mine throughout my professional career, as a teacher, and now as a teacher trainer and researcher.

Throughout my teaching career, students, my fellow colleagues and I had taught, won numerous scholarships, design awards and competitions for their 'outstanding'

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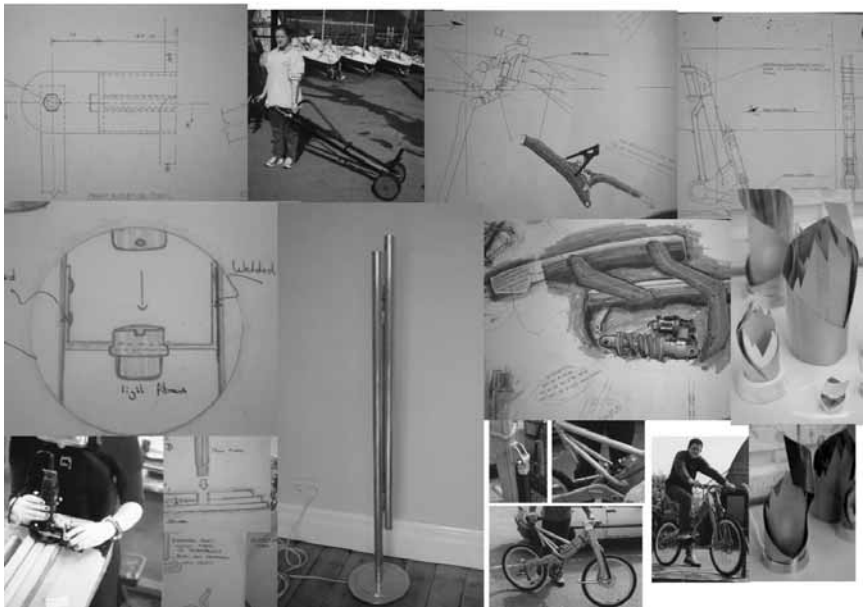

Figure 3. A range of GCSE and A-level work from 1994-1999. Using many strategies to produce creative outcomes

D&T work. Interest from outside bodies for example D&TA, Ofsted, and the BBC to name but a few, made me, with the benefit of hindsight, realise that, the D&T work our students were undertaking, was unusual, that is, not what students were doing in other schools (figure 3).

Furthermore, researchers of the time were very interested in what was going on at Elliott asking, "How do you get your kids to do that work?". Reflecting on this work now, and given my experience as a researcher and my wider reading, I can now begin to understand and explain why the work was apparently so unique. At the time however, I could not have answered this question with any real confidence, even though I had been involved in it directly, that is, experienced it as a classroom teacher. Mouly (1978) suggests however, that if we really want to understand the phenomena presented to our senses, then experience, on its own, is not enough. This is one of my main points for today. I had some good hunches as to what may have contributed towards the quality of the student work in figure 3. But these hunches would have been anecdotal and as we shall see, anecdotes are something we should guard against if we are to understand the nature of the phenomena being studied and if the 'importance and status of technology education' is to be enhanced. A more 'scientific attitude' is required (Robson, 2002; Freeman,1996) and this will be discussed throughout this keynote address by drawing on the research I have been involved with in earnest since January 2005. I will show how this research continues to help me understand the work I did when I was a teacher and influences my work as a teacher educator and researcher today.

A rigorous and systematic approach to understanding D&T

Robson uses the term 'scientific attitude' in an attempt to introduce the aspiring researcher into the complex world of social research and I think it is helpful. I would like to illustrate what he means by this by providing an example from our own research; an externally funded research project from the Gatsby Foundation.

The second phase of this research project trained teachers from the 8 participating schools in the use of creative teaching strategies via regular workshops held at Cambridge University. During one of these workshops, about 18 months into this phase, one teacher from the participating schools told us that parents in his school had lamented the fact that their children had not brought any *craft* artefacts home recently from D&T lessons. One or two teachers in our other participating schools said some of their parents had expressed similar views. One teacher added that parents in her school made voluntary contributions to pay for some of the materials used by students in their D&T lessons, implying that schools had an obligation to ensure craft outcomes went home. Making voluntary contributions is not an uncommon practice in English schools. Thus, the teachers in our participating schools, having *experienced* some parents

commenting on the lack of practical work being brought home, assumed this to mean all parents wanted their children to bring *craft* outcomes home. I thought this was really interesting. I'm not denying that some parents may well have commented on the lack of practical work their children brought home recently in D&T, but when asked to provide a little more detail, the teachers just said that some parents had commented in passing at a recent parents' evening. As a researcher however, I did not arrive at the same conclusions as the teachers. Indeed for me, it raised numerous questions.

Was this an isolated view, held by a few parents, or were their many parents, across all our schools, who lamented the lack of practical work being brought home by their children? If so, was it because some parents had made a financial contribution towards materials the reason why they wanted to see practical work being brought home? Indeed, was it the parents who made voluntary contributions, the ones who were lamenting the lack of practical work being brought home? Did practical work to parents mean craft work? Did parents only value craft outcomes? Did parents not value practical outcomes that were also creative? Did they know what a practical and creative outcome looked like in D&T? Was their conceptualising of the nature of D&T based on their own D&T experiences (e.g. the handicrafts)? These are just some of the questions one could ask parents when trying to *understand* why they had expressed a concern at the lack of practical work being brought home by their child(ren). We just did not know the answer to these questions and it was important to know the answer to questions such as these, as teachers justified teaching craft outcomes to students based on the comments of a few parents. Furthermore, it was important for a research project with a focus to develop students creativity, which includes well made creative practical outcomes, to establish whether parents did in fact want craft products brought home in D&T.

Surveys

What was needed was a more 'scientific attitude' or approach to understand the nature of the phenomena being studied, rather than relying on experience, that is, having heard one or two parents make some comments about practical work being brought home. To this end, we designed a survey which sought to obtain 'parents views about the nature of students work in D&T at KS3 (11-14 years)'. Surveys are useful for many reasons (for an overview Cohen et al, 2007:206), but were particularly useful for our purpose as a survey would:

- either support or refute whether parents wanted craft at home (the main focus of this part of the enquiry). Thus this survey was essentially a confirmatory survey (Cohen et al, 2007: 207)
- Gather standardised information, that is, asking all parents the same questions
- Represents a wide target population. 256 parents across

Figure 4. Images shown to parents, asking preference to be brought home

RESEARCH

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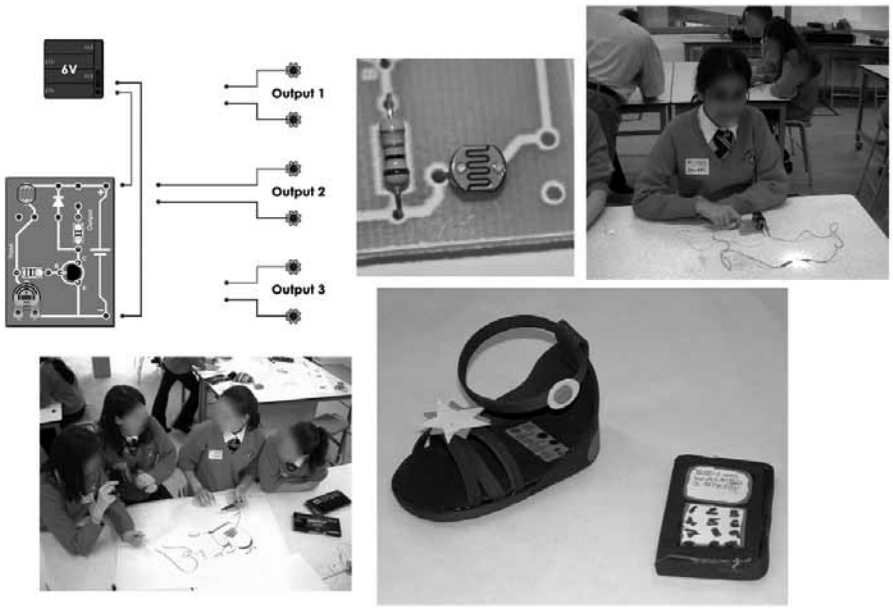

Figure 5. A 'snaphot' of the processes and outcomes of one student's creative idea

7 schools in England were surveyed, during KS3 (11-14 years) parents' evening. It is therefore a purposeful sample (Cohen et al, 2007: 114-115)
- Generates numerical data in a systematic and rigorous way
- Gathers data on a one-shot basis and is therefore economical and efficient

I will focus on several questions here which highlight parental views about students craft outcomes and more creative design outcomes at KS3 (11-14 years). We asked parents which one of the following student outcomes they would most like their child to bring home (figure 4). We then asked parents to rank the others in order of preference to be brought home. Finally, we showed parents a 'snapshot' of the processes which led up to one student's creative idea, an electronic material that can be incorporated into a child's sole of a shoe, which acts as an alarm if the baby wonders too far from the parents (figure 5).

In summary, parents views about the shoe idea changed significantly. Initially, 54% of parents said they wanted the craft box home (the most popular choice), with less than 5% choosing the shoe (the least popular choice). When we asked parents to rank them in preferential order to be brought home, the shoe was ranked last by 46% of parents surveyed. When parents saw the creative thinking processes behind the shoe idea, their opinions changed, *significantly*. 71% were more positive about the shoe outcome, rising to 83% more positive/ slightly more positive. At the time of the survey, the researchers made a note of parents reactions when asked questions relating to thinking processes behind the shoe concept. Parents said things like, "Wow! That's smart", "that's creative", and "I didn't see the value of that to start with". Furthermore, 83% of parents said they were happy for their child to bring this product home now! What these questions illustrate, and our wider survey confirms, is that parents do indeed value creative outcomes in D&T. Thus the survey refuted the assumption made by some teachers that parents only wanted craft brought home. To some observers, this might seem a small point, but to me, it illustrates the difference between relying on anecdotal evidence, one based on experience alone, where 'haphazard events' are used in an 'uncritical manner' or where evidence is often selected which is 'consistent with their [laypeople] hunches and ignoring that which is counter to them' (Cohen, 2007: 5). The alternative approach, the one adopted in the parental survey, is an example of what Robson calls a 'scientific attitude'. Robson describes a 'scientific attitude' towards research as that which is carried out 'systematically, sceptically and ethically' (Robson, 2002 :18). In other words, the teachers' approach was not systematic as they did not give 'serious thought to what they were doing…being explicit about the nature of the observations they made'. Furthermore, the teachers were not sceptical about the observations they made, as they did not subject their beliefs to 'disconfirmation' and 'scrutiny' (Robson,

Validity type and description	Explanation in survey
Content validity-the instrument (survey) must fairly and comprehensively cover the domain in question, that is parents views on the nature of students work in D&T at KS3.	All parents surveyed had children within this age range, including the pilot study. All pictures used in the survey were representative of students work at KS3. All outcomes were excellent examples of their type ie good craft or good creative outcomes as judged by the author and others working on the project.
External validity-the degree to which results can be generalized to wider population	We were not particularly concerned about generalisations, although we did conduct survey in multiple sites, that is 7 schools. We were also aware that the sample were of those parents who attended parents evenings, and there are parents who did not attend parents evening or did not at the times we surveyed. This was a purposeful sample and so we claim it represents itself. (Cohen et al, 2007, p.211).
Construct validity-did parents understand what was being asked about the nature of students D&T work at KS3.	Pilot survey with group of 19 parents to ascertain any ambiguity with respect to the questions we asked – students D&T work at KS3. Much of survey was pictorial, that is, examples of students work at this level and thus we believe was understood/meaningful to parents.
Participant or respondent bias (Robson, 2002:102) eg respondent tries to give answers they think researcher wants.	Some questions were deliberately put onto seperate pages so the respondent couldn't 'read ahead' and influence (bias) their own responses to questions they were answering. The order of some of the questions within the survey differed between the 3 researchers conducting the survey. Again, to help counter any respondent bias.

Table 1. Table showing how various forms of validity were designed into the survey.

2002:18). This is the difference between relying on experience only to understand the nature of the phenomena being investigated as opposed to doing research (Cohen, 2007). Relying on experience then, can lead to the wrong conclusions, that is, findings which might not be credible or can be said to lack validity. If research is not credible, or lacks validity it is worthless (Cohen, 2007). Validity takes many forms, but can be defined here as concerning 'whether the findings are 'really' about what they appear to be about (Robson, 2002:93). For examples of other types of validity used in the design of the survey see Table 1.

Being critical about surveys and questionnaires

So, to understand the nature of the phenomena being investigated, we cannot rely on experience on it's own. The parental survey discussed previously served a particular purpose for our investigation as it found that parents did indeed value creative outcomes and would like them brought home. It helped me to get at, in a more systematic way the hidden 'beliefs, points of view, or attitudes that are held' by parents who attended parents evenings at the 7 schools surveyed (Best, 1970). Surveys and questionnaires have their limitations, as they tend to scratch the surface, rather than provide in-depth or rich data that perhaps an interview could provide (see Cohen, 2007).

I would like to illustrate this point by discussing another type of survey we conducted with students aged 11-14 years across 11 schools. We asked students (N=4996), to tell us their views on a number of topics to do with D&T, by asking them 69 questions on all aspects of D&T, using a multiple choice 4-scale Likert scale (see appendix A for

an example). We asked students to strongly agree/strongly disagree to the item 'I like to make things in D&T'. 95% of students strongly agreed with this item and it was the most popular response. Now what does this tell the researcher? Clearly, students like making things in D&T? But this is all this item tells us. What this item cannot tell us, is what they mean by making. What kind of making? Making Craft products? Creative making? Why do they like making, over say, doing research or sketching ideas, which were two other items on the questionnaire? We need to be sceptical or critical here too, as to the limitations of the questionnaire and what the data can possibly tell us. Questionnaires are an attractive instrument to collect numerical data which can be easy to analyse (Cohen, 2007: 317). These attractions however, should be 'counterbalanced…by the possible unsophistication and the limited scope of the data that are collected, and from the likely flexibility of response' (Cohen, 2007:317). Of course, this is not to suggest questionnaires (or surveys) are not appropriate instruments to use when collecting data. Indeed, their limitations can be what is attractive about them, they can provide a broad, superficial snapshot and this can be really useful (Wilson and McLean 1994:3). This is why the parental survey was such an attractive option for us, to confirm parental views on D&T. This is what it was designed to do, in the time available. The point is, the questionnaire tells us that students like making, but it doesn't describe or explain beyond this very broad statement. It doesn't get at the deeper, hidden meanings of human actions, discussed previously. Let us look at another method of collecting data to see if this provides any insights into students views about making in D&T.

Focus group Interviews

To try and find the answers to the questions listed in the paragraph above, and understand what pupils meant by making and other phenomena relating to D&T, we conducted semi-structured, focus group interviews with 126 students aged 11-16 years across 6 different schools. We asked students about their work in D&T including their likes/dislikes, what research they did, where they got their ideas from and projects they had been working on. We tape recorded their responses and transcribed this data and analysed it using descriptive codes (Miles and Huberman, 1994). We have reported this elsewhere (for a fuller discussion see Nicholl and McLellan, 2007), but I will provide a brief summary here. It was clear that the practical tasks students described during interviews led to each student following a set of procedures which led to all students producing the same craft outcome, as the following excerpts reveal, 'in most of them [D&T lessons] you're told what do to (male, 12 years) and, 'Yeah, they [teachers] give you a design and you got a do that exact design' (male, 15 years). They went on, 'the only difference was how [the colour] you painted it' (male, 15 years) and that, 'They all came out exactly the same. Unless you made a mistake!' (male, 15 years). A particularly insightful quote was from one female student: *I think if you look at everyone's folios and all the research is the same, you've got a specification and you've got an analysis and you've probably got a mood board. Everyone's done that you know and it doesn't take any talent to do that at all (female, 16 years)*

Students told us that doing tasks like this were 'tedious' and 'boring' and this is illustrated by the following excerpt: *Guess what we did last lesson? We copied joints out of a textbook. Then guess what we did next lesson? We made the joints! What's the point in that?' (male, 14 years).*

For me, the student excerpts above, particularly the two longer excerpts, illustrate why we have to be careful not to jump to premature conclusions about what students like about making in D&T, using items on a questionnaire. The focus group interviews we conducted with students, provided rich insights, suggesting a myriad of complex reasons which could help explain why 'I like making in D&T' was the most popular response. It was clear that many students were not entirely positive about the nature of the practical work they were asked to do in their D&T lessons. We shall return to students and practical work later.

So an exclusive reliance on one data method, 'may bias or distort the researcher's picture of the particular slice of reality being investigated' (Cohen et al, 2007, p. 141) and this might influence the credibility or validity of the research. So how might the researcher overcome the limitations by relying on one data method, and at the same time, overcome threats to the credibility or validity of their work? I would like to turn to this now.

Triangulation of data

One way to overcome this issue is to collect data from a number of different sources in an 'attempt to map out, or explain more fully, the richness and complexity of human behaviour' by collecting data from different perspectives or viewpoints (Cohen et al, 2007:141). The research literature calls this process triangulation[3] (Denzin,1989).

3 It should be noted that the process of triangulation can use qualitative data only (e.g. interviews, observations, documentation, fieldnotes) or can be 'mixed' with qualitative methods (e.g. questionnaires).

Data method	Description	Main Focus-to illustrate discussion in this section
Student interviews	Number=126 (semi-structured; focus group-interviews; single sex ie 3 boys/3 girls in each group. 30-45 minutes duration). Tape recorded/transcribed.	Research undertaken (what/when/who decides/how does it help you with ideas?) Idea generation (how/when/how many are expected? Contribution of research?
Teacher interviews	Number=14 (semi-structured interviews. At least two teachers from each school; one being head of department. 45-60 minutes duration) . Tape recorded/transcribed.	Similar to above.
Observation of lessons	10 lessons where students had previously did research and were expected to generate ideas fro a task they were working on. (2 researchers: 1 focussing on teacher; other on students).	Narrative of lesson taken in form of notes which were later typed. Lesson also taped recorded. (Ely et al, 1991)
Fieldnotes	Other information from school visits were recorded ie discussions/thoughts from visit/classroom layout etc	Notes written up immediately after the visit and typed within 24 hours of the visit
Student work	Numerous digital images and of portfolios/artefacts-showing process and product/classroom environment.	Used to illustrate fixation
Documentation	School prospectus; inspection reports; departmental schemes of work	Used to illustrate fixation

Table 2. Data method used in early phase of research project.

Triangulation can be defined 'as the use of two or more methods of data collection in the study of some aspect of human behaviour' (Cohen et al, 2007: 141). Both quantitative and qualitative methods of data collection have their limitations (for example the limitations discussed previously with respect to questionnaires). The researcher needs to be confident that the data generated are not products of the limitations of that particular method (Lin, 1976). Triangulation can help avoid this potential limitation. Furthermore, according to Robson (2002) and Evans (2009), using multiple sources enhances the rigour of the research as it can help reduce threats to validity such as researcher and respondent bias.

In our early work, we used a number data collection methods to explore and thus try to understand why students had difficulty generating creative ideas early on when designing, and in particular, why they seemed to always base their ideas on popular culture, that is love hearts and logos. This was a phenomenon that I experienced from school with Angil and other students I taught and have reported previously (see Nicholl, 2002; 2004). These previous reports however, lacked the scientific attitude I am advocating here, by using the methods discussed previously in a systematic way. These previous reports could not be trusted or said to be trustworthy. I knew students' generated ideas based on popular culture or clichéd designs and thought this was worth researching in a more systematic way; hence the focus for this part of our research. Table 1 summarises the multiple methods selected collected for this part of the research (see Nicholl and McLellan, 2007 for more details).

As you can see from Table 2, there were 6 different methods used for data collection. The main data we used to try to understand the phenomenon of hearts and logos were teacher and student interviews. This was supported

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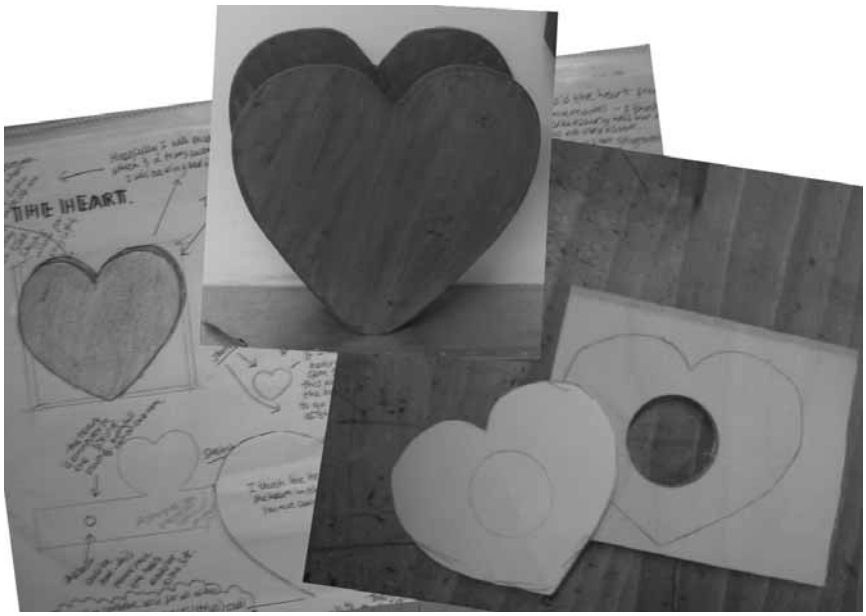

Figure 6. An example of student's design ideas and outcomes, based on popular culture and stereotypical/clichéd design

by photographic evidence (figure 6) and fieldnotes. Before discussing how this data was analysed I would like to discuss some of the literature I had been reading at about this time.

Literature review and research questions

At about the same time as collecting the data above, all members of the research team reviewed the literature on creative cognition, an emerging field of psychology (see Finke et al, 1992). What follows is a summary of the literature we reviewed at this time in relation to children's ideas.

Ward suggests that generative activities that lead to creative ideas have one thing in common; they are all instances of conceptual expansion (Ward et al, 2002; Ward and Sifonis, 1997). This is where people 'extend the boundaries of a conceptual domain by mentally crafting novel instances of the concept (Ward et al, 2002:199). The phrases, 'extending the boundaries,' and 'novel instances' highlight the expectations of creative thinking that goes beyond what is easily predictable (or ideas that are different from other people solving the same problem). Interestingly, a number of studies have shown that when participants have sought to generate novel responses their ideas are often similar to existing ideas. For example, Karmiloff-Smith's (1990) studies showed how the younger pupils in her sample (aged 4-11 years) produced similar drawings given the instructions to draw a house and then to draw a house that did not exist.

Jansson and Smith (1991) showed how both student and professional design engineers, possibly unconsciously, used features in products they had recently viewed and projected them onto their own design ideas when solving similar problems. Furthermore, they did this even when they were asked not to and had also been told that some of the features were bad design features. Jansson & Smith refer to this as a fixated state, or fixation, which 'refers to a blind, and sometimes counterproductive, adherence to a limited set of ideas in the design process' (1991: 4). Further studies by Condoor et al, (1993) arrived at similar conclusions.

Many studies have focussed on how existing knowledge can influence the generation of new ideas – a process that Ward refers to as 'structured imagination' (see Ward, 1994; Ward 1995; Ward and Sifonis, 1997; Weisberg, 1986, 1993).

Structured imagination refers to the fact that when people use their imagination to develop new ideas, those ideas are heavily structured in predictable ways by the properties of existing categories and concepts (Ward, 1995: 157). Ward offers further insights by predicting which aspects of existing knowledge people are likely to 'retrieve' and therefore use in the generation of new ideas (Ward, 1995; Ward 2002). He refers to this as the 'path-of-least resistance' model (Ward, 1994, 1995). For example, when asked to generate novel ideas for tools, two thirds of participants would retrieve the most 'representative'

category (for example in one experiment, a hammer) to help generate new ideas. In other words, 'items that come to mind more quickly and to more people are the ones most likely to be used as sources of information for the development of new ideas' (Ward et al, 2002:203). Thus, returning to the question above, it would appear that fixation is caused when people draw on a limited range of previous knowledge, which is knowledge that readily comes to mind. If this is the case, pupils would be expected to draw on knowledge that is the most readily available to them when they think up design ideas.

A literature review then, can help the researcher keep up to date with current literature on a topic. Consequently, a literature review can help to 'deconstruct prior conceptions of the phenomenon' and can therefore suggest other avenues for conducting future research, which in turn will help our understanding of the phenomenon being studied (Denzin, 1984:11). In this way, a literature search can help focus an enquiry and formulate a really clear and focused research question (Yin, 2003), as it did in our enquiry when we asked the question:

What does fixation look like in D&T 11-16 years?

Analysing data

Having a clear and unambiguous research question means that appropriate data collection methods can be decided on. Once the data is collected, it needs to be analysed in order to arrive at credible conclusions. Cohen et al. (2007) reminds us that, 'the central endeavour in the context of the interpretive paradigm is to understand the subjective world of human experience…to get inside the person and to understand from within' (Cohen et al, 2007:21). Furthermore, the 'actions [of the people being studied] are meaningful to us only in so far as we are able to ascertain the intentions of the actors to share their experiences'(Cohen et al, 2007:21). Meaning, according to interpretive researchers could be seen as 'text', such as interview transcripts, and this could lead to an 'interpretation of meanings made both by the social actors and by the researcher' (Cohen et al, 207:22). How are these meanings interpreted? Whilst possible approaches to analysis can be very diverse, Miles and Huberman suggest that interpretive researchers follow a 'fairly classic set of analytical moves' Miles and Huberman (1994, p.9). These will be described in relation to my own research.

The interview transcripts were read several times in order to familiarise oneself with the content. A set of codes were compiled. 'Codes are tags or labels for assigning units of meaning to the descriptive or inferential information compiled during a study' (Miles and Huberman, 1994: 56). We used descriptive codes which attribute 'a class of phenomenon to a segment of text' (Miles and Huberman, 1994: 57). Codes usually come in the form of phrases, sentences or paragraphs and examples of the descriptive codes can be found in Table 3 below. Codes are used to retrieve and organise chunks of texts, producing categories, based on themes or patterns, that address the research question (Miles and Huberman, 1994: 9). Thus, coded segments were examined for evidence of fixation. We wanted to examine the concept of fixation as it applies the generation of ideas when students solve D&T problems. What emerged from the analysis of the data, were 4 broad categories which addressed this question and these are listed below with some examples of the actual coding evidence (table 3). Coding was done using QSR Nvivo programme (Fraser, 2000).

So, both teacher and student interview data can be used to generate descriptive codes, which can lead to 'small generalisations that cover the consistencies…in the database' (Miles and Huberman, 1994:9). These generalisations are confronted 'with a formalised body of knowledge in the form of constructs or theories' (Miles and Huberman, 1994:9). Thus, for the interpretive researcher, theory 'should not precede research but follow it' (Cohen et al, 2007:22). Miles and Huberman's classic analytic moves, then, can help the interpretive researcher understand, What fixation looks like in D&T 11-16 years? (see Nicholl and McLellan, 2007). This way of analysing data and transforming it, is described by Bernard as 'making complicated things understandable by reducing them to their component parts' (Bernard, 1988). This transformation process is important if research is to inform teacher practice, that is research informing and supporting design and technology education. I have illustrated how the above data was analysed and became 'sets of meanings which yield insight and understanding of people's behaviour' (Cohen et al, 2007:22). Theories therefore, become 'sets of meanings of people behaviour…and are likely to be diverse as the set of human meanings and understandings that they are to explain' (Cohen et al, 2007:22). This illustrates how the researchers' theoretical and epistemological stances influences how data is interpreted, and making sense of human actions. I would like to provide another example of analysing data, by returning to the work discussed previously about students liking to make things in D&T.

4 Questionnaires are appropriate instruments to collect and analyse data. Indeed, sophisticated formulae can be used to analyse data from questionnaires. My point here is that, used simplistically in the way described here, can lead to superficial conclusions.

Categories of pupil fixation	Example of descriptive code from interview data
Stereotypical design ideas	'I made a cushion last year which had purple love hearts on it' (female, 14) I printed off loads of cartoon characters, like winnie the pooh and stuff, which I used for my design' (female, 16) 'Oh yeah, yeah you get lots of love hearts' (D&T teacher)
Design ideas that were similar in style	'sort of like similar sort of type (themes for a board game)…like war games and then football games' (male, 12) 'I think people come up with the same ideas, but slightly different…might be similar and have the same feet positioning' (female, 12)
Acceptance of first idea that is thought of	'As soon as they said come up with an idea for a pencil box (decorate lid design) I already knew that I was gonna do Man United player or just the team' (male, 12) '…I just wanted a dinosaur [for GCSE coursework]' (female, 16) 'They get a fixed image, that's what I want to make. It's very hard to make them see that you can change it and modify this. They're fixed, they think now that's what I want and that's what I'll do' (D&T teacher).
Inability to generate ideas	'…sometimes you have a tough time just thinking what to do' (female, 15) 'When I'm designing…I'll put my pen to paper…but nothing really springs because there's nothing to spring from' (female, 16)

Table 3. Types of descriptive code describing the four broad categories of students exhibiting fixation (11-16 years)

As I have said, a questionnaire item such as 'I like making things in D&T' on it's own doesn't tell us very much[4]. We triangulated the questionnaire data, along with other data such as student and teacher interviews. The data was analysed and what emerged from the data and we have reported is that students did not feel challenged in the tasks they were asked to do in D&T, they felt they did not have ownership of their ideas, and they felt they did not have a say in their own learning (McLellan & Nicholl, 2008, Nicholl & McLellan, 2009). These three findings, students' perceived lack of challenge, lack of autonomy and non ownership of ideas can be linked with other formalised bodies of knowledge (the literature) in the form of helping to construct and support theories (Miles and Huberman, 1994). Relating findings or theories that have emerged from the data (via analysis), to the literature can add to the reliability, that is, the trustworthiness of the study (Evans, 2009). For example, there is much evidence to suggest that these three concepts are very important to motivation in education generally (Anderman & Maehr, 1994; Fredericks, Blumenfield, & Paris, 2004). Furthermore, in our research, we were interested in the literature which suggested motivation was a pre-requisite for creativity (Amabile, 1996; Collins and Amabile, 1999; Sternberg & Lubart, 1999). Thus, these findings had implications for our own research (discussed below). For a full discussion of the relationship between motivation and creativity in the context of D&T see McLellan and Nicholl (2008). Confronting generalisations with a formalised body of knowledge is an important analytic method for interpretive researchers (Miles and Huberman, 1994; Denzin, 2002).

The Epistemological Differences Between a Teacher and Researcher: A personal journey illustrating second order action research

Thus, the importance of engaging with the literature is stated once again.

Investigating fixation as we did above opened up new lines of enquiry, which will help further understand (and explain) the phenomenon being studied, creativity in D&T in secondary education in England. In another investigation, we reported that teachers might be unwittingly contributing towards fixation, in the way they taught students the design strategy, product analysis (see McLellan and Nicholl, forthcoming). In this study, we found that in nearly all cases, students analysed the same products as they were designing. Given what the literature says about design fixation, it is hardly surprising students copy or fixate on properties of existing products, they were asked to analyse. In other words, this can inhibit their abilities to think creatively. These findings are interesting given the fact that analysing existing products is a strategy used by designers commercially (Channel 4, 2000) and is listed in the National Curriculum[5] (see DfES, 1999; DCSF, 2005) and the Key Stage 3 (11-14 years) National Strategy[6] with it's focus on Designing (2004). Indeed, several studies have found that design graduates (Jansson and Smith, 1990) and practising mechanical engineers fixate in similar ways when asked to analyse existing products and generate novel ideas (Condoor, Brock and Burger, 1993). Designers do use product analysis when designing, but they use other strategies too. How do we know? We produced a number of case studies (Yin, 2003) of designers and asked the question: How do designers avoid fixation? Designers we studied used many strategies to avoid fixation, but one told us explicitly "If I was going to design a chair, the last think I would look at is a chair" (See McLellan and Nicholl, forthcoming) Furthermore, these designer case studies have identified a number of processes that designers use to inform their creative thinking (See Nicholl, McLellan and Kotob, 2008a; Nicholl and McLellan and Kotob, 2008b; and figure 7). This in turn, informed a range of strategies to help teachers, help students to think creatively.

Summary

I have described a very personal journey. I started out as teacher of D&T who very quickly recognised that students had problems generating creative ideas, relying on popular culture to generate ideas that were not very creative. This, I now know, might be explained by fixation. I developed and used a range of strategies that seemed to work, but

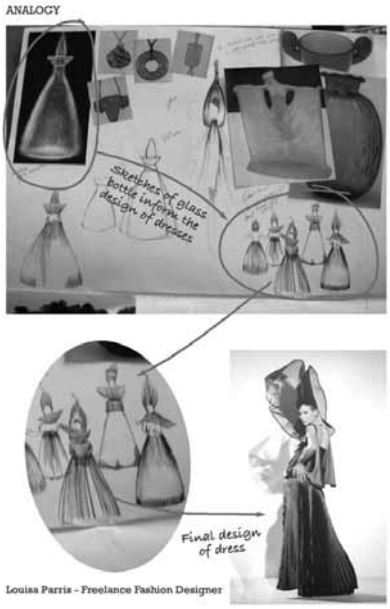

Figure 7. An example of a fashion designer using the creative process: Analogy. The shape and form of an old perfume bottle inspires the design of a dress. All rights reserved, 2009. Cambridge University ©.

did not really understand why. Having been fortunate enough to have studied this phenomenon in a systematic and sceptical way, I now understand that fixation can manifest itself in at least 4 different ways in D&T. I also understand that certain uses of the strategy analysing products, might contribute towards fixation and also that some designers consciously avoid looking at products which were the same as they were designing, in order to deploy thinking away from the path of least resistance and via the creative processes (Nicholl and McLellan, 2008a;b). We found too, that parents do value creative processes and outcomes, and that students are not very motivated by the tasks they currently do in D&T and this has implications for their motivation and ultimately their creativity. The difference between the early part of my career, as a teacher, and now as a researcher, is avoiding relying on my experience only, where haphazard events are used in an uncritical manner. I challenge my assumptions more now, because they might be wrong, even when I am conducting my research. Robson (2002) suggests that by adopting a more 'scientific attitude' where research is conducted 'systematically, sceptically and

5 The National Curriculum is the curriculum stipulated by central government through programmes of study. Government department formerly known as Department of Education and Skills (DfES) and now the Department of Children, Schools and Families (DCSF).

6 Key Stage 3 National Strategy is a strategy to improve standards in Education, with each subject having a particular focus i.e. designing, in Design and Technology

ethically' will help educationalists to 'understand the nature of the phenomenon to our senses' (Cohen et al, 2007:5), in a way that is more 'trustworthy'.

Of course, I have been fortunate enough to have led an externally funded, major research project into creativity and D&T. But teachers too can conduct research 'systematically, sceptically and ethically', to help them understand social phenomena in order to improve their own classroom practice. I have suggested that my journey has an empathy with action research, which has an emphasis on action and reflection with the view to improving practice. The inadequacies of my 'everyday thinking' as a teacher, to that of undertaking a more systematic and rigorous approach required by a researcher, in order to understand social phenomena in the D&T classroom. In drawing on the many examples from my own research, I hope this keynote address has stressed the importance of systematic research. Thus, I hope that my journey will help teachers see how action and reflection in their own classrooms is not only possible, but is necessary. Viewed in this way, this keynote might be an example of second order action research.

Finally, if we accept that systematic enquiry has a crucial role to play in teachers understanding and ultimately the improvement of their own classroom practice, then to my mind, it can only raise the importance and status of design and technology education in the way Dakers (2008) stated at the beginning of this address. Teachers then, can play their part in raising the status of the subject, as this too is important when our subject is under more threat than it has been at any time in it's history.

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Types of questions with Likert scales used to survey students 11-14 years					
1	I like to make things in D&T	Strongly Agree	Agree	Disagree	Strongly disagree
2	You can change how creative you are	Strongly Agree	Agree	Disagree	Strongly disagree
3	Our teachers give us time to work things out	Strongly Agree	Agree	Disagree	Strongly disagree
4	I like doing research	Strongly Agree	Agree	Disagree	Strongly disagree

Appendix A