Researching Design Learning: Research methodology

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Introduction for the 2015 DATA Special Edition

This paper was originally published as a chapter that formed a methodological end-piece for 'Researching Design Learning' - the book that we published in 2007 with Springer publishers. In the chapter we draw together many of the priorities, approaches and 'rules of thumb' that we have developed over the years as our research experience gained momentum and that are exemplified through the research projects described in the book. Through this piece we explore the 'fit' between the values of researchers and their clients and how this has impacted in what we have researched and the ways we have gone about the activity. We explore the lessons learned, the critical role of research design and about the design of research instruments, interventions, data collection and data analysis approaches. We explore some of the approaches we have used for bringing research to life for ourselves and others, making it understandable, meaningful and immediate. We conclude by confirming our view that researching is a very design-like activity.

Springer publishers have kindly agreed to the re-publication of this slightly modified chapter as part of this Special Edition.

This chapter reflects on the ways in which we were emboldened to get into research in the first place and the ways in which we engaged in research as a designerly kind of activity in which we have felt free to exercise our creative talents. This does not mean that we have assumed a license to be dilettante, but rather that, given a specific research challenge, we developed all kinds of tools (sometimes very unusual ones) to give us some purchase on the issue in hand. Sometimes these tools have empowered us to *gather* data more effectively, sometimes to *organise* those data in new ways, sometimes to *analyse* data and sometimes in the *presentation* of data. We conclude with the point that researching is a very design-like activity.

Starting points and the challenge of values

Any research methods guide will underline the importance of getting a clear starting point, and we would absolutely agree with that. Teasing out the questions that one is trying to answer through the research is a necessary and sometimes complex process. The more precise the questions are, the easier it is to decide what will count as data to enable us to answer them. Part of the complexity in this process of elucidating research questions derives from the common occurrence that the clients/sponsors of research are unclear themselves about exactly what they want. It frequently takes a good deal of negotiating to dig out what they *really* want to know. The process is just the same as when a lay-person commissions a designer or architect or gardener to generate a new product/living space/garden. The lay-person will typically have some vague notions of what they want. They might have cut out pictures from magazines or (in rare cases) sketched for themselves what is in their head.

But it then remains the job of the designer/architect/gardener to bring their expertise to the task. This is 'what-if' time. What if it was like this? What if it did that? Would it be good if? Would you like it to do that? In doing this, the creator is not throwing *solutions* at the client, but is rather trying to tease out their response to see what excites or interests them. The process is all about digging out the *values* that the client is trying to embody in the work. Are we after a peaceful/tranquil garden space; or a formal architectural space; or a space of light and movement; or; or; or.

It is precisely the same with research clients. We offer up tentative solution-types to gauge reaction and thereby get a better grip on what is really wanted. Are they looking for a *statistic* that will convince a policy body or a collection of case study examples to *illuminate practice*? Or do they seek to shape that practice in particular ways? Not infrequently the client will say 'yes' 'yes' and 'yes'… we will have all of that. At which point it is our turn to point out that *everything* is not an option unless there is lots of time and money. So we help them to prioritise what they *really* want, and what might be a nice added extra. These underlying value debates then directly shape what we might do in the research both to aid our understanding of the issues in the data and to help our clients and stakeholders to get messages across.

But teasing out the clients' priorities is only part of the complexity of finding a starting point. For overlaying them are the priorities that we ourselves bring to the task. We are not just jobbing researchers looking to earn a crust by doing anyone's bidding. We have our own set of priorities

– typically concerning designing and learning – that we are always interested to understand better. Since we are reasonably well known in research circles, most of the clients that approach us do so knowing that these are our concerns. It is therefore not difficult to find research questions that are appropriate for the client and of interest to us. But there have been some cataclysmic fallings-out over this matter, and the project in 1991/2 in which we developed the first round of KS3 Technology SATs (formal, externally set, Standard Assessment Tasks – SATs - for 14 year olds) provides an interesting case.

This was a hugely valuable project that we obviously wished to be a success. But this eventually proved impossible because of the conflict in values between what the client, the School Examinations and Assessment Council (SEAC), wanted and what we were prepared to do. We worked quite comfortably on the first round of development and produced a set of prototype SATs that seemed good to us (they produced the important data to inform learners' performance against the requirements for the National Curriculum for design and technology). But as we moved towards the second round of development, the terms of the brief were drawn far more starkly. SEAC really did want tests – with right answers – that could be marked with certainty against a checklist. We wanted test *activities* (like the ones we have previously created for the Assessment of Performance Unit (APU) ones (Kimbell, et. al., 1991), which could be assessed using teacher judgements.

We were not prepared to develop tests of the kind that SEAC demanded, since we judged the position of SEAC to be completely wrong at every level; for schools, for teachers, for learners and for design & technology more widely. So we did not do it and we were removed from the development process. And we lost a huge amount of money. This one case brought home to us very clearly that client values and researcher values have to be (at least somewhat) aligned before any research venture can succeed.

Research Design

Assuming that a clear set of questions has emerged from the negotiations establishing a project, the research design becomes a critical aspect, and moreover a part that offers great opportunities for creative thinking. From the priorities identified at the outset we have to create a *design* for the research that stands some chance of achieving the desired outcome. What are we going to do? How are we going to do it? Central to the answer to both these questions is another one: what will count as data?

Think yourself into our shoes at the outset of the *Decisions by Design* project for the Design Council (Kimbell et. al., 1997; Kimbell and Stables, 2007). We had an absolute alignment of their values and priorities with our own. They were interested (and so were we) to see how the lay-person's everyday decision-making process might be the same as, or different from designerly decision making. How might we do that?

The context of the project lay in schools (the Design Council's 'Total Schools Design' initiative) so it made sense to us to think about lay people in schools. Since we would need cooperation at a reasonably high level, it also made sense to target the school management team. We also wanted to have both primary and secondary schools involved. But how many? And from which schools? We already recognised that if we were to get at their decision-making processes, we would need some significant blocks of time working with them to allow them to develop sufficient trust in us. We also wanted to be able to sit around a table with them all at one time.

Using these thought processes we settled on the idea of six teacher fellows (three primary and three secondary) each selected from the school's management team, and committed to giving 12 days of their time to the project over a year. But that was only half the problem, for where would we get the contrasted designerly decision makers – and how would we get them together?

Goldsmiths has a flourishing PGCE programme of teacher education, and each year we take in a group of fresh young design graduates who have an interest in becoming teachers. So we had a captive audience of trained designers. Could use them?

In the end, we operated a double procedure. First – mostly in their own schools and in their own time – the teacher fellows were asked to draft a 'fly on the wall' description of what had happened in their school when an important decision gets made; e.g. about school development planning, budget making, timing for a new school day, or disciplinary procedures. We wanted a full account of how the decision came to be made, recording all the things that might have contributed to that specific decision-making process. The aim was to gain a comprehensive account of why and how the decision got made in the way that it did.

Then, through the subsequent term, the teacher fellows observed our PGCE designers at work on a group-based design project. Four sessions were dedicated to working with students who were asked to work as they would normally do in design activities. Each group had a teacher

fellow assigned to follow their development. Throughout the term the teacher fellows took on the roles of participant-observers in these design activities, and moreover they were required to reflect upon their experiences:

- Analysing the design techniques used
- Debating their strengths and limitations
- Reflecting on the transferability to other problems and settings.

In the end, the teacher fellows were astonishingly lucid about the differences between their own and the design students' decision-making processes. This research design – as with all research designs – was in part based on debates of principle. But at the same time it was also based in part on the pragmatics of what can be done in the time available and with the resource at our disposal.

We could have done something very different. We might have sent questionnaires to thousands of people (some designers and some not) inviting them to tell us about their decision-making processes. We might then have analysed the differences and (possibly) derived some statistically solid data. We judged however – as a point of principle – that we had to put our 'subjects' into decision-making mode and ask them to observe and reflect upon what happened. This is far more demanding and time consuming, but (in our judgement) far more likely to reveal the realities of decision-making. Having made that research design decision of principle, we then had to manage the pragmatic consequences of who, when, where and how. Perhaps we should note here that we have never – ever – used blanket questionnaire techniques. We believe that questionnaires can be useful when administered in person to get particular bits of information from people we have worked with and who understand what we are doing and why we are doing it. But our own response to 'blind' questionnaires through the post or on the High Street makes us vary wary indeed of attaching any significance at all to any resulting 'findings' from such blunderbuss techniques. We also recognise, however, that this instinct is informed by our basic philosophy of research, which is to lean more towards interpretive than positivist models.

The challenge of research design frequently rests on the trade-off we have illustrated here from *Decisions by Design*. What we would like to do in principle – set against what we have the resources (time/money/expertise) to bring to the task. The end result has to be convincing and worthwhile, but equally it has to be do-able.

Instrument design

It has frequently been the case that our projects have involved the development of new instruments for promoting learner performance or for collecting data of one kind or another. Once again it is our designer instincts that pop to the surface when faced with these challenges.

For our first project (APU) we developed some very different response booklets for learners to work through over a 90-minute design task. This and subsequent versions (e.g. for Assessing Design Innovation and for e-scape; Kimbell & Stables 2007) are cases of instrument design where the priority is to find ways of promoting design performance in a short time but without losing the integrity of real designing behaviour. In fact, in these cases, the booklets have to be seen alongside an administrator script and an assessment rubric. Together they comprise the 'instrument' and a huge amount of time, experimentation, trialling and modifying was involved in the original and subsequent versions.

But a very different challenge arose in the *Understanding Technological Approaches (UTA)* project (Kimbell et. al., 1994) that we undertook immediately after the *APU* experience. We were very aware of the limitations of the APU determined to investigate 'real' project work, over 'real' time, and with all year groups from Year 1 to Year 11. This was 1992 and the National Curriculum had made design & technology compulsory for all learners throughout these compulsory years of schooling. So what went on in these projects? Did teachers do the same kinds of things in all these years? The research design issues were interesting and essentially we settled on an approach that required us to be *observers* of activity in the classroom. But as any research manual will testify, being an 'observer' is far from straightforward. Do we intervene and ask questions of the learners or not (participant or non-participant observers). Do we record the process with audio or video? Do we explain who we are and what we are doing – or do we pretend to be wallpaper? The question that dominated our thinking was 'what is it we are going to observe'? A class full of learners working on a task will generate a prodigious amount of 'stuff' to be observed. Are they smiling or frowning? Talking or silent? Working in groups or alone? With numbers or drawings or words? Engaged or off-task? Undertaking interesting or banal work? Mechanical or visual or digital? And so on ad infinitum.

Moreover, the research design was based on using a small team of researcher-observers, each taking a set of schools and somehow observing the *same things*. We had to decide what *was* to be observed and what was *not*. We had to develop an instrument that would allow simple (but

specific) observations to be transformed into recorded data. It was, by some distance, the most comprehensive observation-based project we have undertaken, and the instrument we developed for it had a number of interesting features.

Designing effective observation

The first challenge arose from the fact that we were, in each school, attempting to observe a **process** in action; a process of design & development by learners, managed by teachers. But whilst processes are continuous, observations represent a moment in time. So how many moments need to be observed in order to gain a 'true' record of the evolving process? This is a bit like plotting points on a graph. How many data points are needed to render a valid representation of the curve?

The question is informed by how long it takes to make the observation. Is it an instant thing or does it take 30 seconds, or 1 minute, or 2 minutes? As an example, if we were really trying to observe how much of a lesson the learners were smiling and how much they were frowning, then that is pretty well an instant decision and the observer can just hit a tick/cross list. But there are 25 learners in the class, and 25 ticks/crosses will take (maybe) 1 minute in total. So for any one learner we end up with *episodic* data – every minute. But we still get (say) 90 bits of data per learner per double lesson, and in reality of course we need FAR more other data to make sense of their activity.

What and who to observe?

All kinds of data might inform our understanding of what is going on. We would like to know about the *task* they are undertaking; about the specific *subtask* that they are doing at this moment; about whether they are doing it alone or in a *group;* about whether the teacher is *interacting* with them or not; about what *kind* of interaction it is; about their *engagement* with the task (motivated or disenchanted) and so on. Once again, all this takes a significant amount of time (say 1 minutes). But there are 25 of them in the class – so now we have episodic data every 25 minutes on an individual. This is clearly not adequate to reflect the evolving activity. We were forced by this process to focus our observation not just on specific things but on specific learners; and we chose four learners in each group to follow in detail. The choice of these four was done very carefully in discussion with the teacher. We asked to follow:

- The very best designer
- Two middle of the road designers (ideally one male/one female)
- A low ability learner who was nonetheless making progress with design & technology.

All four needed to be good attenders as there was little point collecting a huge quantity of data on learners who were frequently absent. The decision to follow four learners was made in association with other related decisions and involved a difficult optimising process:

- How many observations do we want to make?
- How long does it take to make them?
- How many learners can we follow?
- How episodic does the data therefore become?

In the end we evolved a system with an episodic cycle time of 5 minutes. In that time we could observe the detailed behaviour of four learners across a rich variety of data. But our decision might have been different. It might have been more data on fewer individuals; or more data on more individuals with a longer episodic cycle. This is the hard stuff of design decision making in research.

Transforming text notes into tick-lists

To an extent we were able to speed up the process of data capture. Initially, we just had an A4 pages with lines ruled across it leaving us with 50 mm of space for each 5 minutes in which we scribbled as furiously as we could to capture what was going on. We had a time box in each slot and could fill that in before the lesson started (e.g. 9.05, 9.10, 9.15, etc.), and we then used the empty space to make notes on what was happening. We had four sheets – one for each learner.

Through a series of school trials we gradually derived a list of things that we believed were more important than other things and that were happening all the time – like communicating. So we evolved a tick box to identify whether there was a teacher/learner interaction at the moment of observation. More than that we were able to identify what *kind of interaction* it was, at least in terms of who initiated the interaction. Was it initiated by the teacher (providing guidance/instruction to the whole class or to a subgroup containing our observed learner) or to the individual learner? Or was the interaction initiated by the learner (seeking specific support from the teacher)? Two ticks in related boxes could now represent a complex interaction, the noting of which had previously taken a lot of free text.

Pace

Having observed only a few lessons it became obvious to us that we needed some measure of the learners' engagement with the task. We wanted to distinguish between learners who were disenchanted or disengaged or just off-task, from those that were fully engaged, crashing ahead purposefully and at pace. In trying to record

these data we identified a middle category who were in what might be termed 'tick-over' mode; doing enough to be seen (by the teacher) to be working, but more going through the motions than making real progress.

We evolved a categorisation of these behaviours into a three-point tick box:
- **Stationary** – going nowhere/off-task
- **Poddling** – in tick-over mode
- **Motoring** – fully engaged, making real dynamic progress

With intervening categories (e.g. between poddling and motoring) we had a 5-point scale to capture this level of engagement. It proved very easy and reliable to note and the resulting data rendered really valuable insights into learning and teaching practices.

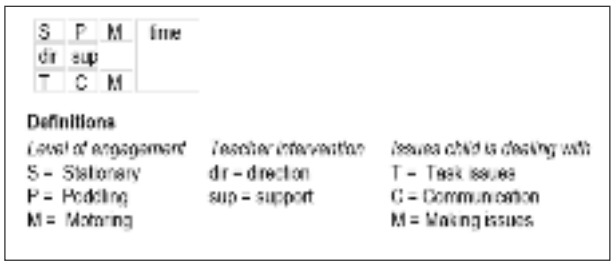

Figure 1. Engagement and interaction elements of the observation framework

Behaviour or intention?

One of the problems of observation data is that some of the important things that are happening in a classroom are not observable. This is not because the learners are hidden behind a cupboard or facing the wrong way – but because the important thing is literally not externalised as behaviour. Rather it is going on at an inner level of cognitive processing. One of these inner levels that interested us a great deal was learners' design intentions. You cannot *observe* intention. It is not a *what* thing or a *how* thing, but a *why* thing. As a result of repeated trials we had created a list of observable behaviours enabling us to capture (with a simple tick) all kinds of workshop-related activity – are learners measuring, cutting, filing, shaping, drawing, etc. The lists initially got longer and then shortened as we categorised and streamlined them. But designing is *purposive* behaviour and the more we collected the behavioural data the less important it seemed to be. Does it matter if a learner is filing a shape out of a piece of acrylic sheet or whether they are hammering a piece of metal? What matters is why they are doing it.

- Is the acrylic filing in order to produce a finished *object* or *component*?
- Or is it to produce a *template* that can be marked around to produce standard components?
- Or is it to produce a *transparent template* that can be marked around at the same time as seeing something important through it?

These different ways of thinking that might inform the edge-filing of a piece of acrylic might reflect significantly different levels of designerly behaviour. Even though the behaviour is the same.

The only person who knows what the intention is of a piece of behaviour, is the person exhibiting that behaviour. So we were committed to talking to learners about what they were doing in order that we could understand why they were doing it. It was for this reason – amongst others – that we chose to be *quasi-participants* in the observed lessons; rather than pretending to be wallpaper. However, our questioning always remained 'neutral' seeking out why they were doing something rather than commenting on whether we thought it a good thing to do, or suggesting other things that they might be doing. The learners became accustomed to us constantly moving around the room noting things on pads, and that we might occasionally wander over to see (and ask about) how they were getting on.

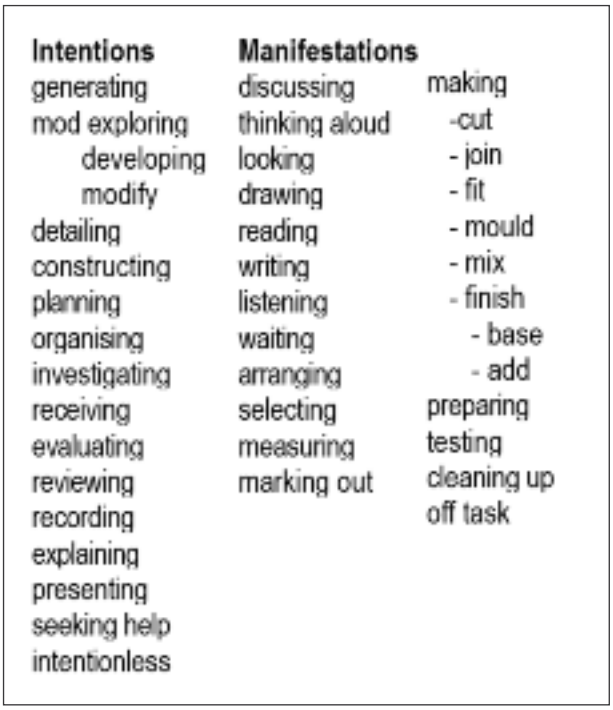

Figure 2 The list of design intentions and their manifestation noted on the observation sheet

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We acknowledge that this observation process will also have changed to some extent the behaviour being observed. This is the perennial dilemma of the observer. The more you get involved, the more you find out. But the more you get involved the more you influence what happens, when what you really want to know is what would be happening if you were not there. There are difficult trade-offs to be made here, but the importance of *intention* in design behaviour is so overwhelming that we were obliged to gather it. Often we felt confident in *inferring* an intention from the combination of behaviours we had noted. But occasionally we had no alternative but to ask. Noting the intentions behind the behaviours and the way the behaviours were manifest, gave a rich picture of the different ways learners approached their designing.

Bringing data alive: the art of data compression

The *UTA* project generated oodles of data collected from countless hours of observation. *APU Design & Technology* (Kimbell et. al, 1991) that preceded it, had generated even more – though this was test performance data from a huge sample. But the question inevitably arises with so much data. How should we set about making sense of it all?

Our general approach to data analysis has typically involved a search for patterns in the data and (being designerly folk) we work better with visual patterns than with any other kind. So wherever possible we find ways to represent the data graphically so that trends and anomalies stand out as visual signposts to something interesting that might be happening.

This approach was one we developed during *APU Design & Technology*, very much supported by the team's decision to buy its first Apple Macintosh computer. Up till this time we relied on posing a research 'hunch' to the team's statistician who went away to run a very time consuming data analysis process on the College mainframe computer, producing for us (often 24 hours later) the answer to a question we were no longer interested in. With the introduction of our first 'Mac', we could suddenly explore the data for ourselves, ably supported by the statistician, and utilise the Mac's simple graphics software to visualise our findings. The following examples illustrate this approach.

First, when exploring data on the comparative analysis of girls of different abilities, we noted that sometimes the lower ability girls did considerably worse than the mid-ability girls, whilst sometimes they were almost on a par with them. Our hunch was that this had something to do with the way the tests were structured, and so we presented the data in such a way that the most loosely structured tests were at one end of a continuum, the most tightly structured at the other. As can be seen from Figure 3 below, the more tightly structured the test, the better the performance of the lower ability girls – and equally interesting – the apparent lack of importance this has for high ability girls.

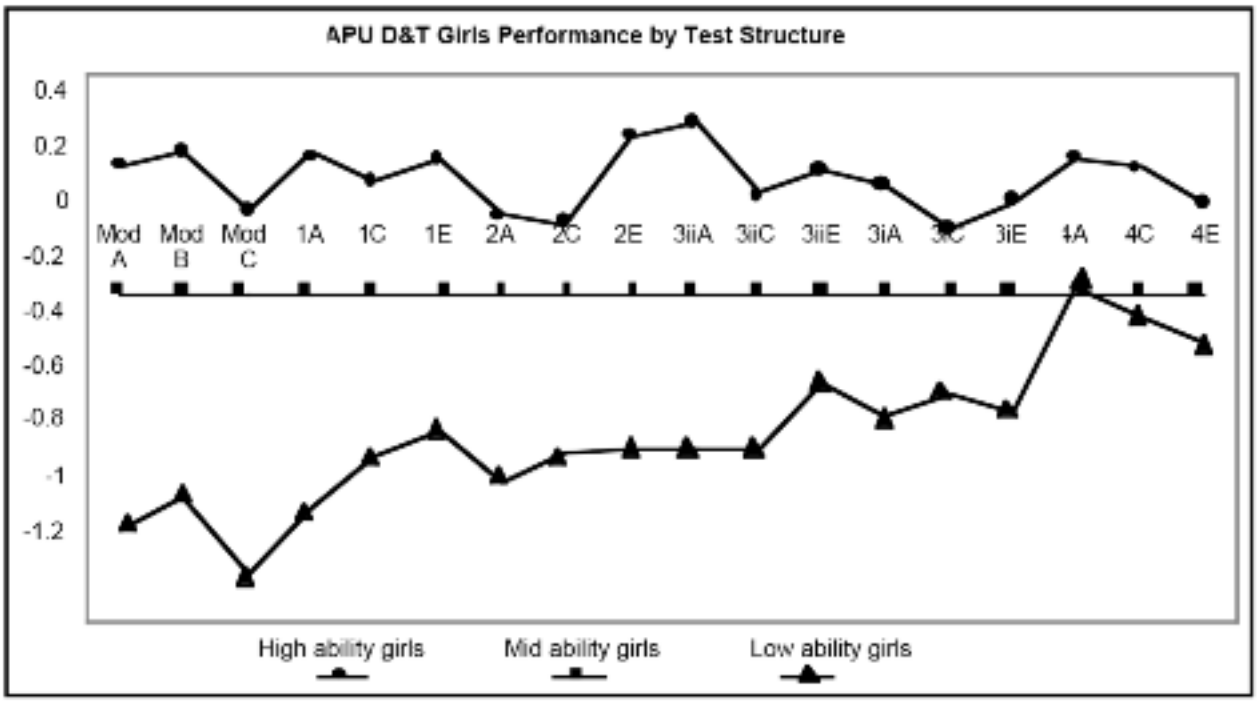

Figure 3. Presenting performance data based on loose/ tight task structures in the APU project

APU holistic performance by context (A, C & E) and gender

* indicates 5% sig.
** indicates 1% sig.

	People	Environment	Industry
T.1 Boys	2.19	2.03	1.71
T.1 Girls	2.42 *	2	1.95*
T.2 Boys	1.89	1.77	1.99
T.2 Girls	2.02	1.85	2.21**
T.3i Boys	1.97	2.23	1.87**
T.3i Girls	2.06	2.19	1.58
T.3ii Boys	1.96	1.8	2.41
T.3ii Girls	2.08	1.77	2.29
T.4 Boys	2.15	2.09	1.96
T.4 Girls	2.5**	2.40**	2.29**
Mod Boys	2.29	2.55	2.65*
Mod Girls	2.38	2.37	2.38

Figure 4. Average holistic performance data across all tests in the APU project

Using graphics helped us make sense of the data for ourselves – and also when communicating this with others. By contrast, we show below the raw composite data from the APU project for holistic performance of girls and boys across the three design contexts that the tests were set in. To the naked eye, it seems an unintelligible set of figures.

As we considered this data we were conscious of a gender effect related the context of the test – girls tending to outperform boys when the context focused heavily on people, more mixed effects when the focus was on industry and virtually no effect when the emphasis was on the environment. Presenting the data in a graphic form makes this effect far more visible, as is shown in Figure 5.

Giving further consideration to the 'mixed messages' of the industry- focused test, we became aware that there were two effects in the data – context *and* test structure. At times these effects were working in the same way for a gender group, at times they were working in opposition. So once again, using the same raw data, we could show these different effects graphically.

The *UTA* project also provided several classic examples of how this pattern-seeking approach yielded interesting interpretations of the work that learners were undertaking. The starting point in seeking patterns involved developing approaches that make it possible to compress huge quantities of data into relatively simple data sets. First, we entered all the observations as raw data in a spreadsheet. So, taking the example of *interaction* between teacher and learner, we had a column in the data record showing (for

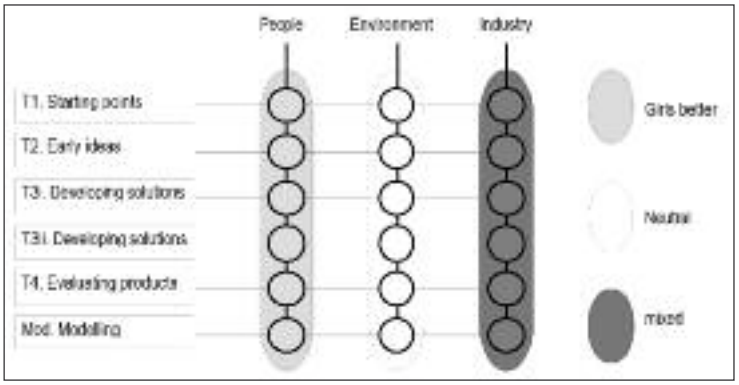

Figure 5. Graphical presentation of the numerical performance data

every 5 minutes period) whether the learner was interacting with the teacher and – if so what kind of interaction it was (e.g. *directive* from the teacher or *supportive* sought by the learner). These data were represented in a single code within the column, and the column ran for the entire duration of the project. A typical case was a project with 14 year olds that ran for 485 min, with 97 units of coded data.

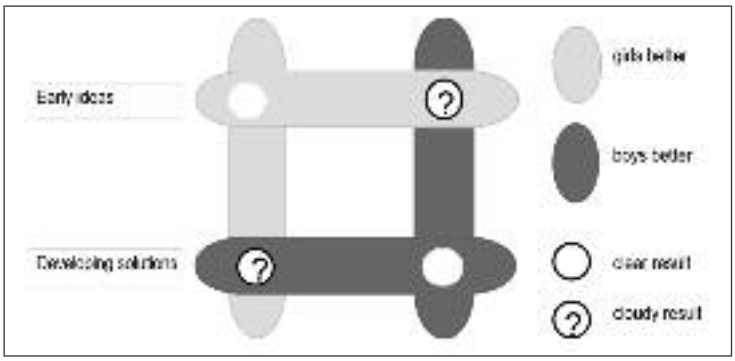

Figure 6. Graphical presentation of numerical data to indicate the effects of context and test structure

From this data we could see, over the life of a project, what percentage of time the learner was seeking support from the teacher, and conversely what percentage of time teachers were being directive. Since we had identical data across all 11 years, it was then a simple matter to represent it graphically (Figure 7). With startling consequences, for immediately it became obvious that something odd happens in the transition from Year 6 to Year 7.

However, whilst charts of this kind are highly informative of generic data, they also tend to hide *trends* in data because of the averaging effect across the life of the project. Since we were concerned with designing as a real-time rolling

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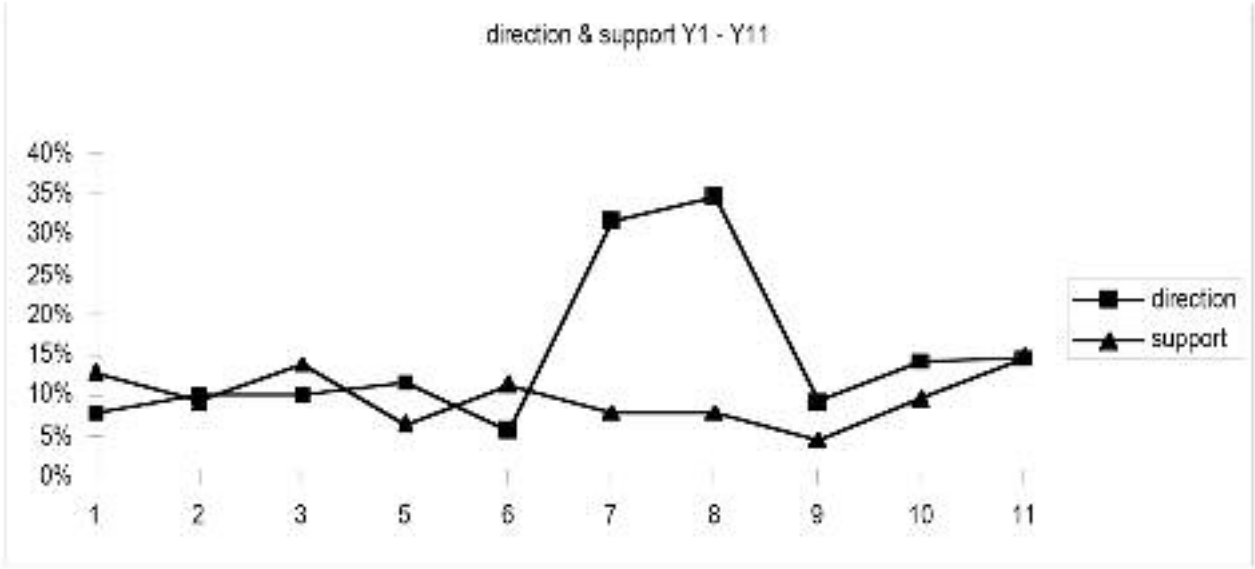

Figure 7. The levels of teacher direction and support across the UTA projects

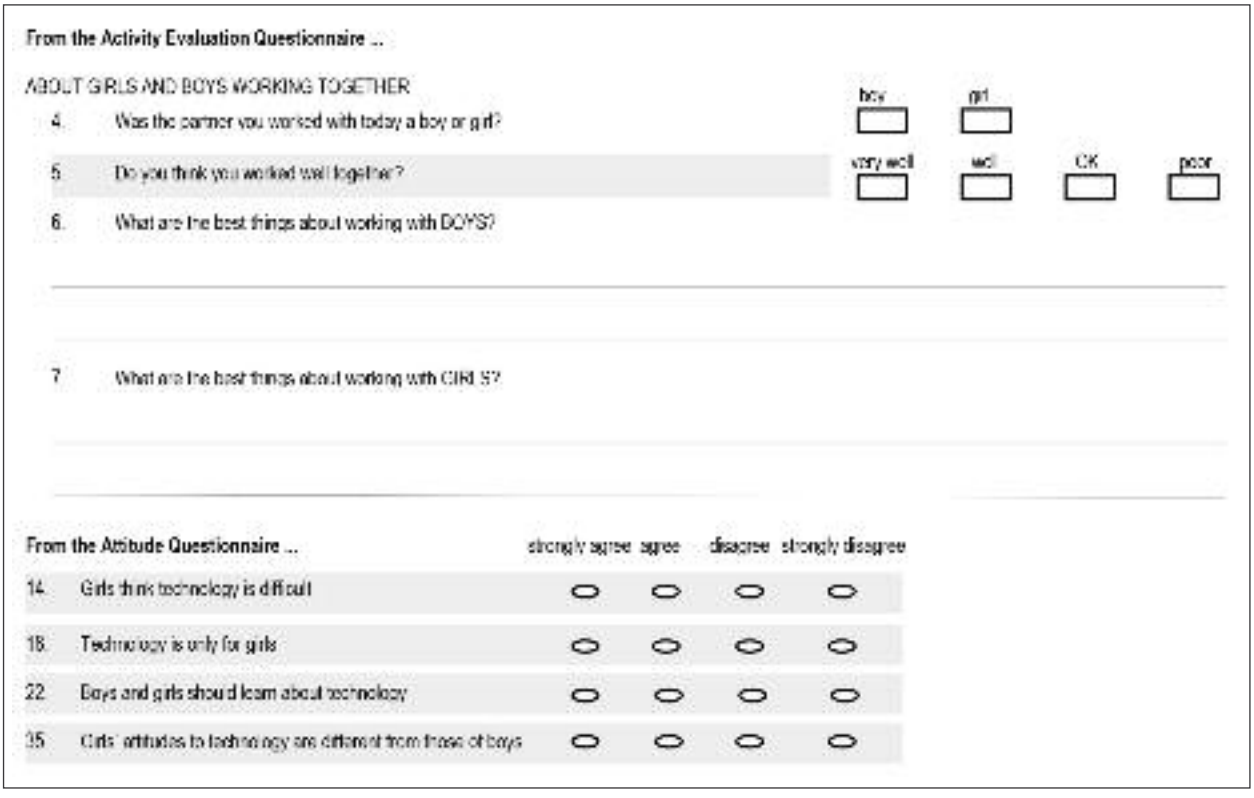

Figure 8. Collecting qualitative and quantitative data in the North West Province Technology Education Project Evaluation

process we clustered the data into five project phases, created simply by taking the first 20% of project time as phase 1, then the second 20% and so on. The resulting data-maps were *condensations* of the data. We referred to these condensations as *data-maps* since they enabled us to take huge amounts of data and reduce it down to a form in which we could create simple graphic representations of the trends that lay within it. (This is illustrated more fully in the Gender differences in technology paper, also included in this Special Edition).

Gathering data from different perspectives

As has been clear throughout the projects, we have been equally comfortable with combining research approaches – qualitative and quantitative, and different tools – if we judged they would provide us with rich data to inform our research questions. This has involved us, for example, developing parallel interview structures, where effectively the same question is being asked to different stakeholders. A clear example of this was in the *North West Province Technology Education Project* (Stables et. al., 1999; Kimbell & Stables 2007) where we used the same question structure to interview teachers involved in the project, their school principals, provincial and NGO officers, and through group interviews, the learners themselves. We have used this approach in a number of projects as the approach helps us to gain insight into an issue or situation from a range of perspectives.

A further approach to gaining a rounded, fuller picture of an issue has been to gather linked qualitative and quantitative data, the former allowing us to explore patterns and trends in the data, the latter to *illuminate* those trends and speculate on their meaning. The *North West Province Technology Education Project* also provides an example of how we collected a range of data that helped us to explore gender differences in and between the learners from schools involved in the initiative and those from the control schools. Figure 8 illustrates different types of data we collected: demographic data (the gender of the respondent and who they worked with); quantitative data about whether they worked well together and what their attitude to gender-related aspects of technology were; and qualitative data through a 'free response' question on the 'best things' about working with boys and girls. The composite insights provided allowed us, for example, to examine in detail the collaborative dimension developed through the initiative (Stables, 2000) and the capability and attitudes it enhanced (Stables & Kimbell, 2001).

Visualisation to support data capture

The process of rendering abstract ideas into visual form is something that we have consistently sought to do, and not just for analysis and interpretation purposes. Two other instances are worth a brief reference. In the *North West Province Technology Education Project*, learners were assessed on design tasks derived from a similar approach to the APU project and the resulting work was to be assessed by associate researchers from the project development team who had to be trained in making holistic assessments. We decided to operate this through a two-stage process. First, using an assessment rubric, we worked through the learners' responses looking for evidence of the qualities identified in the rubric. Second, having identified the evidence, we sought to attach values to it, enabling us to assess all the work consistently.

It was in the first of these processes that we used a very simple, but effective, visualisation tool. We provided 'high-lighter' pens for the assessor team, using different colours for different qualities in the rubric. This highlighting process – done in pairs – then led to a group debate about the qualities concerned. Is this an example of quality X … and if so does it reflect high level performance or poor performance? Do you agree that that is an example of quality Y … and so on.

This sharing process – based on highlighted evidence – proved very helpful to assessors who were then moving on to value the work.

A different kind of visual approach was used for data capture in *Attitudes of Potential Teachers* (Kimbell and Miller, 2000). We were interviewing graduates from design, engineering and related degree programmes to tell us about their experience of design & technology in schools. Rather than merely present them with a bald list of bullet points to complete, we sought to appeal to more graphic/designerly instincts, and created the thumbs up/thumbs down images (Figure 9). They wrote their keywords inside these two images. We cannot say that it worked better than bald listing, but it did create an impression and it did work.

In both these cases the techniques might be thought to be barely noteworthy. But data capture is often a delicate and difficult exercise. In the first case (assessors colour coding) the learner responses are highly complex with many kinds of qualities interlinked and overlapping. The colour coding was a do-able task that simplified the process of assessment, perhaps not by a lot, but maybe by just enough to make a difference. In the second case, we can

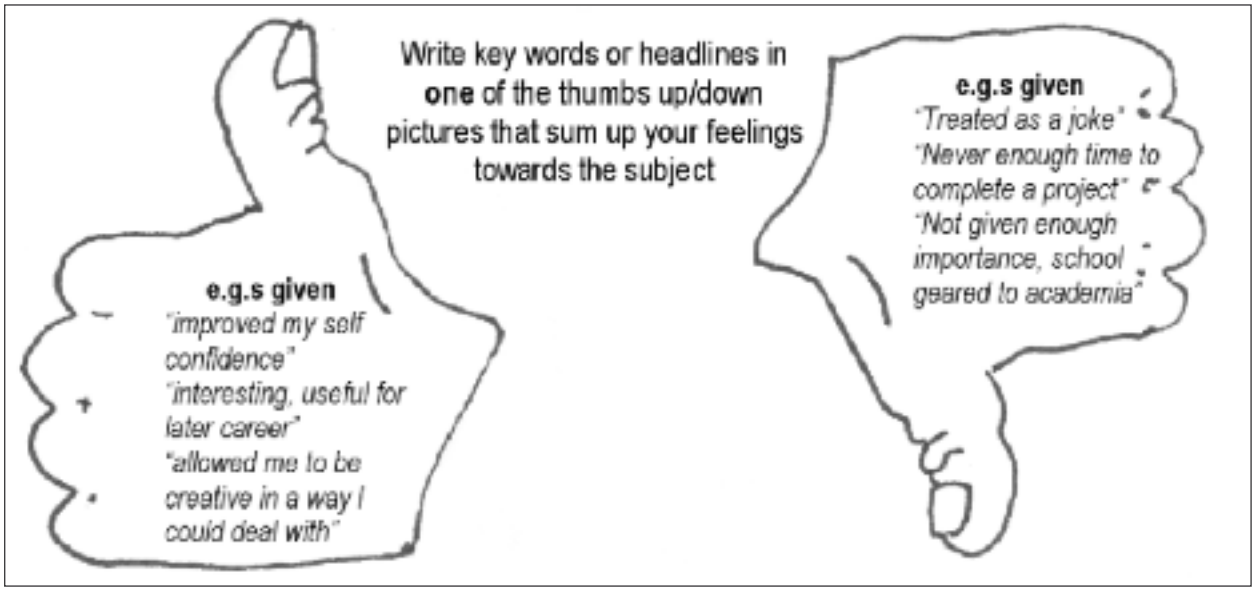

Figure 9. Using 'Thumbs up, thumbs down' to collect key words for positive and negative experiences

sympathise with those who find filling in forms a tedious process. So anything that we can do to lighten the task – and maybe raise a smile – is worth doing. It might just make the difference between engagement and disengagement. It is also an approach we have increasingly used with learners – as young as 8 years old – where the symbol of the thumbs give more instantaneous meaning than words could.

This latter technique also exemplifies how we have typically used everyday, and often vernacular, language to create metaphors for concepts we wish to share with research participants – as we did with the use of *stationary*, *poddling* and *motoring* as metaphors for learner engagement and pace. We have also used a *wow* <> *yawn* continuum for assessing creativity.

Research as Design, Design as Research

We recognise that the form of this chapter has implied a degree of linearity to the process of research. *First*, sort out your research questions; *then* resolve the research design; *then* design the data capture system…and so on. We tried several ways to organise the story of our research approach, and in the end it seemed best to do it this way. But we would like to enter a caveat here that cautions against a too sequential view of research processes.

Whilst it is broadly true that sorting out research questions is a primary task, and that it leads into questions about research design, as soon as we get inside a task we have found it helpful – and even necessary – to model what the data might look like and how we might capture it. This modelling process typically involves not only mock-ups of instruments of one kind or another – but also trials to see what happens when they get used. Sometimes this process reveals other features of the research task that we (perhaps belatedly) come to see as important and decide to find out about – so we modify the research design, redesign the instruments and trial it all again.

As with designing, the process is iterative; starting with a view of how we think the research task will shape up and what it involves, and then moving forward through a series of iterative steps (innovation–modelling–trialling, reviewing: innovation–modelling–trialling–reviewing) until we get to the point at which we think enough of the confusion is ironed out and the instruments work sufficiently well and reveal enough of the things we are interested in. Because at some point we have to draw a line under these iterations, cross our fingers, and just press the 'go' button.

The whole researching process is, as we keep saying, just like designing.

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