5 Interpreting the map: methods of evaluation and analysis

CHAPTER OVERVIEW

5.1 EVALUATION, ANALYSIS AND INTERPRETATION

Evaluating methodology and methods

> Analysis is not about adhering to any one correct approach or set of right techniques; it is imaginative, artful, flexible and reflexive. It should also be methodical, scholarly, and intellectually rigorous. (Coffey and Atkinson, 1996, p. 10)

In any research project, the methodology and methods used need to be evaluated as to their effectiveness in structuring the research and generating/yielding good quality data. This is an essential part of demonstrating the rigour of the research. If the overall methodology turns out to be inappropriate then this throws the validity of the research into question. For instance, much of the early research into creativity adopted a purely scientific approach, trying to 'measure' and 'explain' the 'results', rather than understand the person and the process in relation to the outcomes. This early research is now considered unreliable in many ways.

Similarly, flaws in the choice and application of research methods will produce data that will be limited in providing useful evidence for analysis, for example a poorly structured interview schedule, inaudible audio tapes, sloppy transcription. It is better to revise and re-apply the method rather than attempt what will be an ill-fated analysis! This is why the piloting of all methods is so crucial. However, if revision and reapplication are not possible then at least the limitations of the research must be critically evaluated and discussed as part of the analysis of your research project.

Validity and reliability: towards research quality

Two key terms appeared in the last section – validity and reliability. These concepts (and others, as we shall see later) are concerned with establishing research quality. In

scientific methodologies, objectivity, validity, reliability and replicatability are the cornerstones of research quality. Put simply, these are concerned with making sure that the research is understood by other scientists (consensible) and there is general agreement amongst them (consensual). The issue of shared standards is important, but in alternative research paradigms different terms have been developed which are more suitable for human inquiry, and inquiry which is 'real world' and practice-based. Tesch (1990) summarizes well the position of qualitative researchers:

> Qualitative research is to a large degree an art. The question of its validity does not depend on replicable outcomes. It depends on the employment of a data 'reduction' process that leads to a result that others can accept as representing the data. The result of the analysis is, in fact, a representation in the same sense that an artist can, with a few strokes of the pen, create an image of a face that we would recognise if we saw the original in a crowd. The details are lacking, but a good 'reduction' not only selects and emphasises the essential features, it retains the vividness of the personality in the rendition of the face. In the same way a successful qualitative data reduction, while removing us from the freshness of the original, presents us instead with an image that we can grasp as the 'essence', where we otherwise would have been flooded with detail and left with hardly a perception of the phenomena at all. (Tesch, 1990, p. 304)

Instead of using the terms 'validity' and 'reliability' in their scientific sense, 'trustworthiness' has been suggested as being more appropriate for naturalistic inquiry (Lincoln and Guba, 1985). Robson (1993) suggests that by asking yourself key questions a sense of how believable and trustworthy your research has been can begin to be established:

> Have you done a good, thorough and honest job? Have you tried to explore, describe, explain in an open and unbiased way, or are you more concerned with delivering the required answer or selecting the evidence to support a case? If you can't answer these questions with yes, yes and no respectively, then your findings are essentially worthless. . . . (Robson, 1993, p. 66)

Trustworthiness still encompasses the term 'validity' but in a modified sense. Validity is concerned with whether the research findings make sense, and are credible to the research context – its users, our peers, our readers. Trustworthiness also encompasses 'generalizability' – the extent to which the research findings are more generally applicable (transferable) to other contexts. In qualitative research, the development of criteria for evaluating research quality is a discursive task, involving inter-subjectivity and negotiation. We work towards shared approaches and being able to speak the same research language, whilst not necessarily being in complete agreement![1]

Spectacles and sieves: criteria

Most researchers would concur that preliminary evaluation and analysis take place in parallel with data generation/collection and are iterative, reflexive activities. At best they are playful and creative, yet rigorous. There are many parallels between the

construction of an art/design work and the construction of a research argument, not least in the way that the form is proposed, critiqued, deconstructed, remodelled, and resolved. Much of this process is evaluative and analytical, reflective and deconstructive, creative and synthetic. As practitioners we engage in these activities constantly and most of the time unconsciously. As reflective researchers we must make these activities explicit and accessible.

To recap from Chapter 4 (Section 4.4) evaluation and analysis are two distinct activities:

- to 'evaluate' is to ascertain the value of something and to judge or assess its worth;
- to 'analyse' is to examine something in detail in order to discover its meaning.

However, nothing can be evaluated or analysed without criteria with which to make judgements/assessments. For example, what makes 'good' design could be articulated in relation to three key criteria: effectiveness, efficiency, economy. These, in turn, could be 'unpacked' to provide more focused criteria, for example effectiveness in relation to context and aesthetics; efficiency in terms of function and use; economy in terms of cost and use of materials. It is essential that the criteria you develop relate to the aim and objectives of the research. For example, if your research aims to develop an understanding of the use of multimedia to practitioners in Art and Design then the criteria for evaluation and analysis should focus on, for instance, the user-friendliness or otherwise of the technologies involved, the problems/challenges that emerge for users, the benefits and limitation of multimedia for practitioners, and the impact of the technologies/media on practitioners' working processes and products.

Criteria are like spectacles and sieves: they are the means by which we focus, capture and distil value and meaning. Different spectacle lenses allow us to see in various ways – to see some things whilst not being distracted by others, for example Polaroid sunglasses can allow us to see below the surface of water by eliminating glare. Different meshes in sieves allow us to capture some things while discarding others, for example in panning for gold. Conversely, paper coffee filters capture the unpalatable grounds leaving us with the essential distilled liquid. These different lenses, meshes, filters are metaphors for the sets of criteria by which we evaluate, analyse and make sense of research outcomes (Figure 5.1).

But how do we know that these tools are appropriate? The best way is to try them out! Never assume that your initial set of criteria is perfect. As soon as you try to apply them they might reveal their inadequacies. It is a good idea to talk through your criteria with a colleague. As soon as you try to explain your criteria and how you have arrived at them, questions can be asked and discussion can reveal strengths and weaknesses. Your criteria for evaluation and analysis should be robust, transparent and related to the research context. You should explain the context in which the criteria have been generated. For the purposes of this discussion let us presume that the methods you have employed have provided usable data for analysis, and that you have an initial set of criteria – different kinds of spectacles and sieves! We can now look at how we might analyse the resulting information.

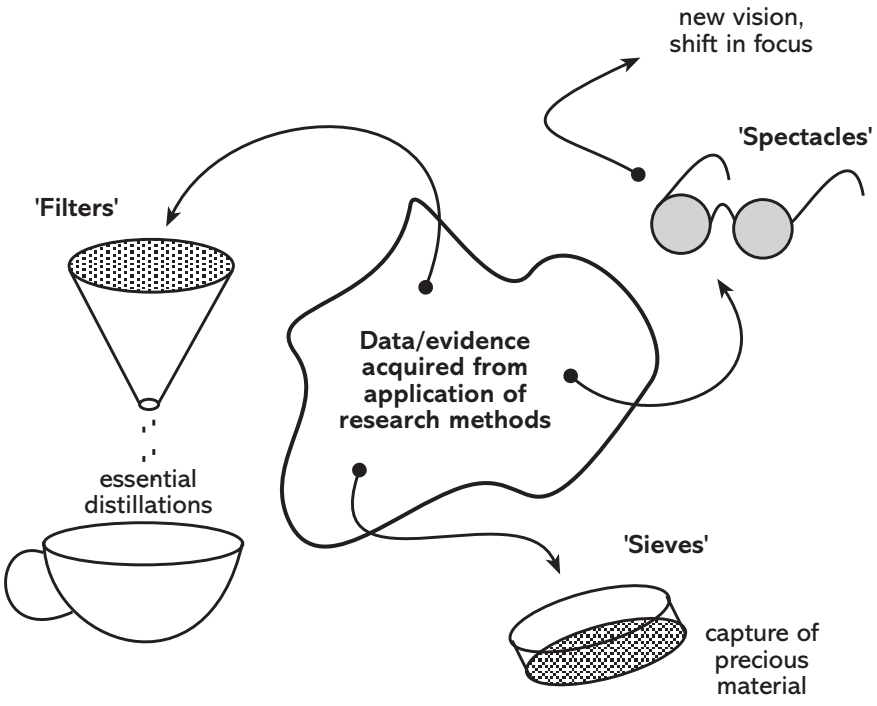

Figure 5.1 Spectacles, sieves and filters provide metaphors for different criteria in analysing data (💻)

Analysis: some considerations

As usual in practice-based research in Art and Design, there is no 'right way' to analyse research findings. Coffey and Atkinson urge us to be 'artful' and 'imaginative' but also 'rigorous'. Qualitative analysis is 'intellectual craftsmanship' – playful but methodical and intellectually competent. The parallels with our own discipline's processes and values are encouraging and inspiring. Imagination, crafted construction and artful persuasion are things to which we can relate. Integrate these with critical thinking and response – essential intellectual elements of the creative process – and we have a sound basis for analysis.

From the key texts available[2] and from our own experiences of practice-based research, there are some considerations that may be helpful in considering the process of analysis:

- Analysis is not the last phase in the research process. It is concurrent with data gathering/generation and is cyclic/iterative, serving to inform and drive each other.
- The broad aim of analysis is to look for meanings and understanding.
- Analysis begins by taking into account all the data to achieve a sense of the whole.

The data can then divided up into meaningful units (segmented and categorized), but a connection to the whole must be maintained.

- Analysis is a systematic process, requiring discipline and perseverance.
- Data analysis encompasses any approach to reduce the complexity in the data material, and to come to a coherent interpretation of what is and what is not the case.
- Analysis is a reflective activity, aiming to move from the data to a conceptual level. It is helpful to track this reflection (using notes/journal). This record of reflection not only helps in shifting from detail to big picture, but also provides accountability of the analytical process.
- Data can be categorized either in relation to some organizing system; for example, criteria related to the research questions and/or a conceptual framework, or 'interrogated' through an inductive process where categories emerge as a result.
- There must be a clear and explicit rationale for the criteria used in analysis and these criteria must be applied with consistency.
- The main intellectual tool of analysis is comparison. The aim is to discover similarities and/or differences by the use of comparison and contrast. This helps to form categories, establish boundaries, find inconsistencies, discover patterns and connections, and paint the larger picture beyond the specific detail.
- There are various visual devices for sorting and structuring data, for example a matrix, mind maps, network diagrams, and so on; for a text – marking, highlighting/colour coding (relating to criteria), adding notes and comments, graphical representations, note cards/'Post its'. (Some of these are described in Section 5.3.) Try out different devices. This process is tentative and preliminary at the beginning and must remain flexible. Be prepared to modify. Do not get locked into conclusions too early.
- Analysis is an eclectic activity. Play with the data and immerse yourself in it. The creative involvement of the researcher is important, but this must be tracked/recorded for accountability. Use the data to think with.
- In many research areas (involving human inquiry) the research outcomes are negotiated between the researcher and the participants in the research so as to create resonance and shared meaning.
- Be sceptical and alert to the limits of evidence. If evidence is inadequate then this must be acknowledged.
- Employ alternative strategies, for example work in two ways: quickly and imaginatively in order to create insights, and slowly and methodically for close reading and reflection.
- An interpretation develops/evolves through both visual and discursive analysis. As this occurs it is important to revisit the raw material to ensure that a 'chain of evidence'/audit trail is clear.
- The result of analysis is some type of higher-level synthesis and interpretation. Although much of analysis is taking apart, the final goal is emergence of a larger consolidated picture, for example a composite summary, a description of patterns/themes, an identification of a fundamental structure, a new concept or theory, new/alternative meanings.
- Analysis is never exhaustive and never really finished. It is complete to a degree when

the specific question or point has been addressed, and therefore it is important to state the scope/confines of the analysis. Analysis ends only after new data no longer generate new insights – the process exhausts the data.

Frameworks for analysis

Depending on your research area, there may already exist useful 'organizing systems' for analysis you might use. Trying to make sense of your data through such conceptual/theoretical frameworks is a useful analytical strategy. These existing frameworks may need to be adapted in some way. It is extremely important that such frameworks be acknowledged and detailed references given. Here are some examples of analytical frameworks from recent formal research.

In *On the Notion of Test* (Douglas, 1997) John Cage's 'conditions for improvisation' in music were used as a framework for Douglas's analysis of understanding the structure of improvization in the development of her own sculpture. Using Cage's 'conditions' as a basis (structure, method, form, frequency and duration, timbre and amplitude) Douglas related these to making sculpture and produced a set of criteria for her own analysis. (This multimedia essay is included in 'Sculpture, Method, Research', 1997, but only in a Mac version.)

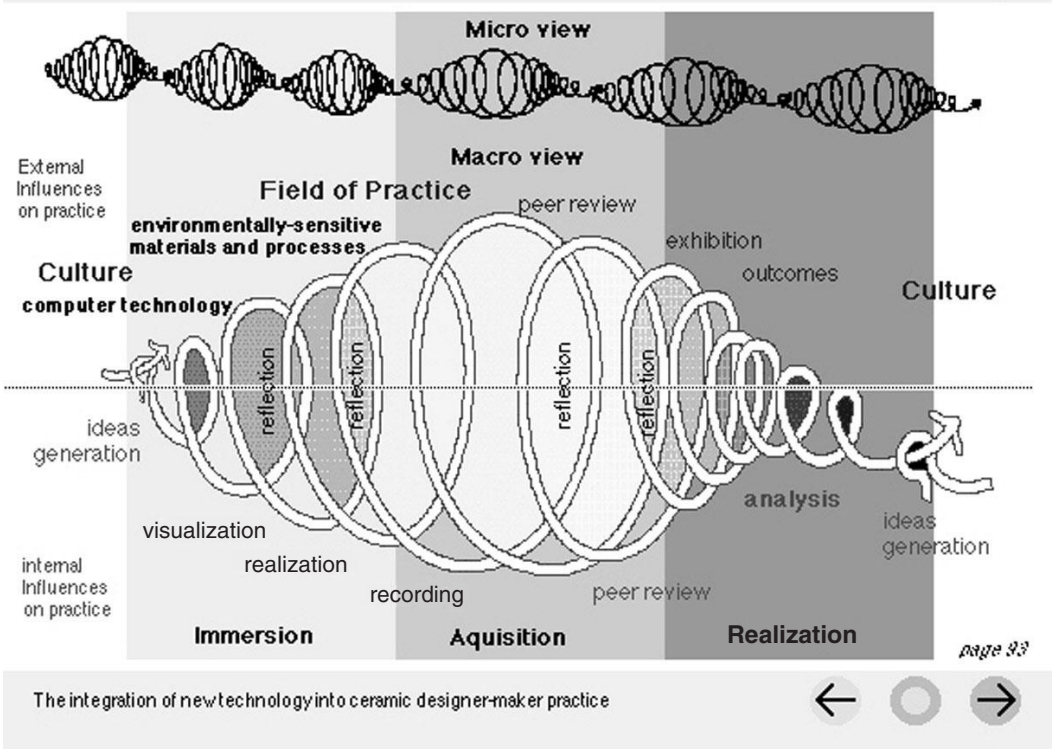

Figure 5.2 A visual model of the researcher's creative process (💻) (from Bunnell, 1998 – thesis in digital format)

Both Bunnell (1998) and Silver (1999) made use of Getzels and Csikszentmihalyi's model of artists' creativity as an analytical framework. Bunnell used the model in order to extend her understanding of her own creative process and make it more explicit (PhD thesis – described as part of Methodology, Section 3.3.2, and also in Analysis, Section 4.4).

Silver used the model in order to analyse three artists' generative processes in her research on the role of artists in public contexts. Data from a case study project – 'Taming Goliath' – was analysed using a technique of 'code-and-retrieve' to track certain generic strands (criteria) derived from Getzels and Csikszentmihalyi's model. This was probably the first application of the 'sweatbox' method (reflection in and on action captured through video – see Chapter 4, Section 4.3) combined with content analysis techniques in art and design research.

The use of existing frameworks for analysis also help to link your research outcomes to established research. This does not mean that your outcomes simply reinforce or extend the status quo – they might well do – but they may also challenge it, and propose something alternative in its place.

Making sense

The outcome of the analysis is usually some kind of higher level synthesis – a big picture, an interpretation. The process of interpretation necessitates 'going beyond the data' to develop ideas that might be valuable and applicable in wider contexts. This stage of 'generalization' is an important indicator of research quality. An honest evaluation of the scope of the transferability of the research must be made. Most practice-based and qualitative research is case and context specific, transferable in broad principles but usually not in specific detail.

Interpretation is only *one* version, *one* reading of the research outcomes from the perspective of the researcher. Again, Douglas (1997) provides us with a helpful overview of the paradigm of interpretation in relation to practice-based research:

> Contemporary Hermeneutics, unlike Positivism in science and technology and Structuralism within social science (anthropology), acknowledges a diachronic, changing, dynamic view of its subject, as opposed to a synchronic, cross-sectional view. In doing so it allows for multi-meaning as opposed to the functional language of science and technology, where words carry single meanings. (Douglas, 1997, section: *The Paradigm of Hermeneutics*).

A hermeneutic approach seeks to 'elucidate and make explicit our practical understanding of human actions by providing interpretations of them' (Packer, 1985, p. 1088). This idea of making explicit practical understandings and making sense of them in appropriate ways is important in art and design research.

Your interpretation (related to your argument) must be based on the available evidence, and all research evidence must be accessible to others in order that they could make *their own* interpretations if necessary. This is why most primary data should be available as part of the research report or dissertation/thesis. This usually takes the form of appendices. (More information on this in Chapter 6, Section 6.2.) The accessibility of the data allows for multiple meanings to be developed.

However, essential though your interpretation is, in 'naturalistic inquiry' it is sometimes necessary to negotiate research outcomes as part of establishing the trustworthiness of the research. This is a dialogic process – through conversations with others (peers, supervisors) you can propose different interpretations and get some feedback. You may think it appropriate, especially if you have engaged participants or collaborators in your research, to discuss your interpretation with them. In human inquiry this process is called 'communicative validation' where the outcomes of the research are fed back to the respondents/participants who are asked to agree/disagree to ensure their situation/views are not misrepresented. This kind of feedback and negotiation may prompt you to reconsider some issues, to revisit the data, and to revise your interpretation. The analytical process should be flexible and iterative.

Finally, let us return to the metaphor of the research journey. This chapter is about *Interpreting the Map*. You should now be in a new position on the map, probably on higher ground so that you can look back and over the landscape. In reflecting on this view you should be able to see where you have been and what kind of terrain you have crossed. You should be able to say if your 'vehicles' were trustworthy and have enabled you to cross the terrain effectively. You should be able to sense that you are now on new ground and have a view from it that you could not see before – both back and forward. You should be able to make sense of where you are and what possible tracks you could take next. Can you see other researchers in the terrain? What is your relative position to them? Will your paths cross in the next part of the journey?

Reflection and action: suggestions

- Can you answer Robson's questions about the credibility of your research?
- Identify two possible existing analytical frameworks that may be helpful to your research analysis.
- If the concept of 'negotiated outcomes' is relevant for you, how might you conduct this with the participants in your research?

5.2 EXAMPLES OF ANALYSIS FROM COMPLETED FORMAL RESEARCH IN ART AND DESIGN

As there are many different approaches to analysis, it is essential to consider as many examples as possible to get a feel for what approaches are acceptable and what methods have been formally validated. ARIAD (www.ariad.co.uk) provides access to examples of completed formal research in Art and Design. In using the Index look out for examples of particular analytical strategies, frameworks and methods. The Research Training Initiative also provides a selection of case studies of completed research in Art and Design (http://www.biad.uce.ac.uk/research/index.html). Similarly, it may be useful to consider examples from other disciplines, especially the performing arts and humanities. The Index to Theses (www.theses.com) may be helpful in this. Just a few examples of analysis are presented here. All have their limitations and they are neither

exhaustive nor comprehensive, but they should give you some leads in your wider search.

Analysis using triangulation

Although essentially a social science thesis on 'Teaching styles in higher art education', Gray (1988) made a conscious attempt to develop methodological procedures that were more qualitative, visual and interactive. Her analysis involved three perspectives – that is, a triangulation (Figure 5.3):

- lecturers' perceptions of their own teaching styles (captured through a 3D 'game' model);
- students' perceptions of lecturers' styles (captured through audio interviews);
- the researcher's perceptions and observations (extended by video documentation of studio teaching).

Preliminary interviews with students and lecturers identified 14 'important factors in teaching'. These factors (criteria, in fact) were used to interrogate the data generated from the various methods. Corroboration between the three perceptions supported the argument that different teaching styles did exist and could be distinctly characterized.

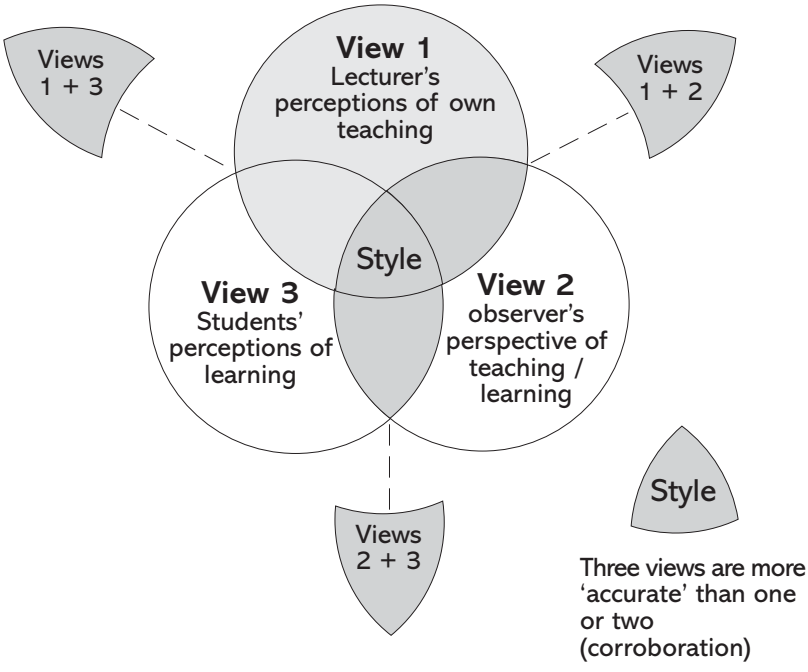

Figure 5.3 Three methods used to provide different perspectives on the central issue – teaching styles (💻)

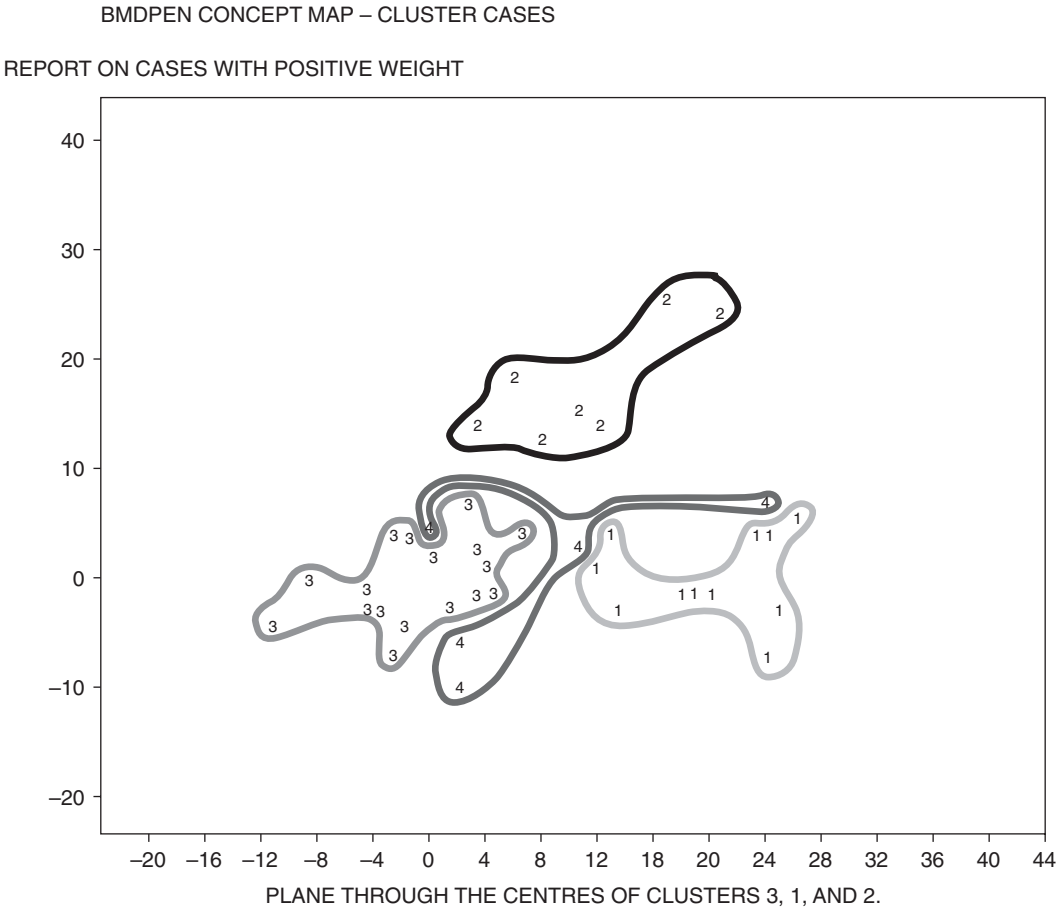

Figure 5.4 Example of a cluster map indicating four different teaching styles

The analysis involved playing with the data in order to see patterns. Many different visualizations were tried, none of which were available 'off the peg', but were invented or adapted. One of the main methods used was *cluster analysis*. Although this technique is basically used for sorting out large volumes of data using a computer program, its principle is useful in that what is sought is the identification of 'groupings'. This analytical process relies on the criteria of likeness/similarities and differences/contrasts in order to generate clusters or typologies. The program usually provides visual maps of clusters, which can help the researcher to describe relationships between clusters, and identify specific characteristics of each cluster.

The analysis proved to be the hardest part of the research, but the most enjoyable. Initially the naïve expectation was that styles existed 'out there' waiting to be discovered. In fact, the eventual set of teaching styles was a 'construction' made from the available evidence.

Visual analysis: two examples

Douglas started using multimedia towards the end of her PhD (1992) as she sought out the most appropriate methods to present her practice-based research. In subsequent post-doctoral research she produced a multimedia essay – *On the Notion of Test* – which makes a visual analysis of her PhD research, and its development from a positivist paradigm to a hermeneutic one. In the essay, Douglas provides a visual and interactive overview of the whole development over time and in relation to the philosophical and working context. The main framework for analysis is Cage's 'conditions for improvisation' that Douglas adopts and adapts in order to analyse and interpret her own sculpture.

The PhD work is analysed in a series of matrices, where each sculpture (information in columns) is interrogated in relation to a number of 'constants', for example structure, form, method, materials (information in rows). The intersecting cells contained the analysis. The matrix structure allows for a comparative analysis of the body of work (Figure 5.5).

As a multimedia document, the essay allows for hyper-linked levels of information within one matrix. This kind of multimedia matrix goes beyond a two-dimensional

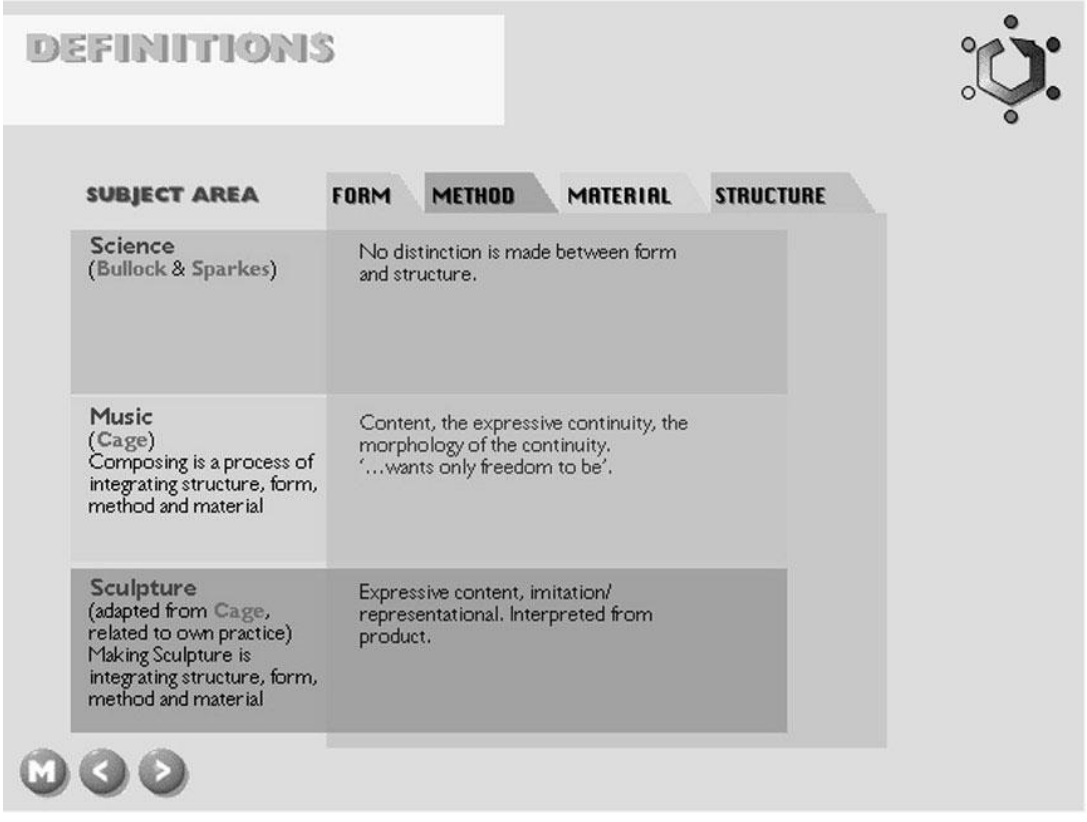

Figure 5.5 Hyper-linked matrix structure for comparative analysis of form, method, material, structure in science, music and sculpture (💻)

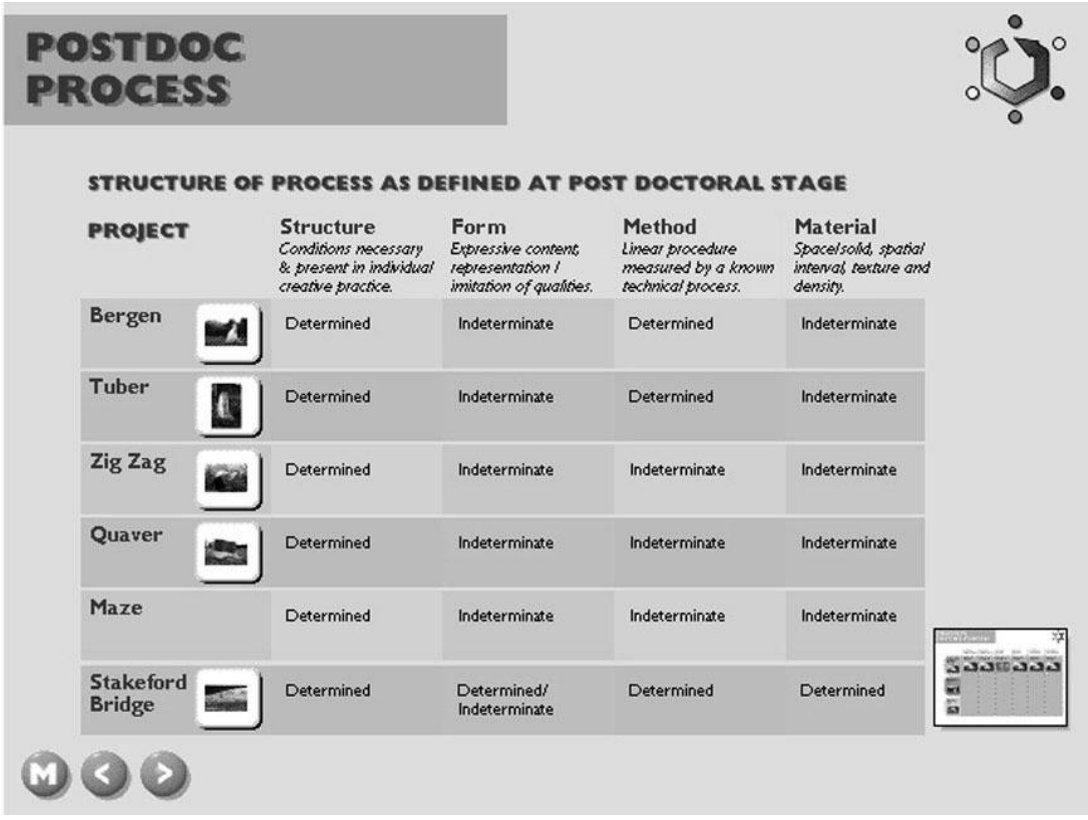

Figure 5.6 Hyper-linked matrix structure for comparative analysis of form, method, material, structure in six different sculptures (💻)

matrix in providing an extensive set of data that can include text, visuals (still and moving), animations, and sound (Figure 5.6). The essay also provides 'slide shows' of each work in development including detailed textual information, for example the process of mould making, texture, site, and so on.

In terms of making an analysis and presenting it, the multimedia matrix can give direct access to the data (located in deep levels of the matrix), as well as presenting a holistic interpretation.

Bunnell's research resulted in a PhD thesis submitted in digital format (as a CD – 'Integration of new technology into designer-maker ceramic practice', 1998). This allowed the inclusion of a great deal of interactive visual material to comprehensively describe her investigation: still images of experimental and resolved work, video of lustre glaze effects, interactive diagrams, 2D visualization and 3D modelling techniques. The thesis was constructed using a series of linked databases. In a similar way to Douglas' multimedia essay, the storage and organization of data within these databases enabled direct access to evidence, which could be used as part of her analysis. The analysis (Section 4 of the PhD) attempted to be as visual as possible. An overview of the analysis is offered appropriately enough on a 'plate' (Figure 5.7).

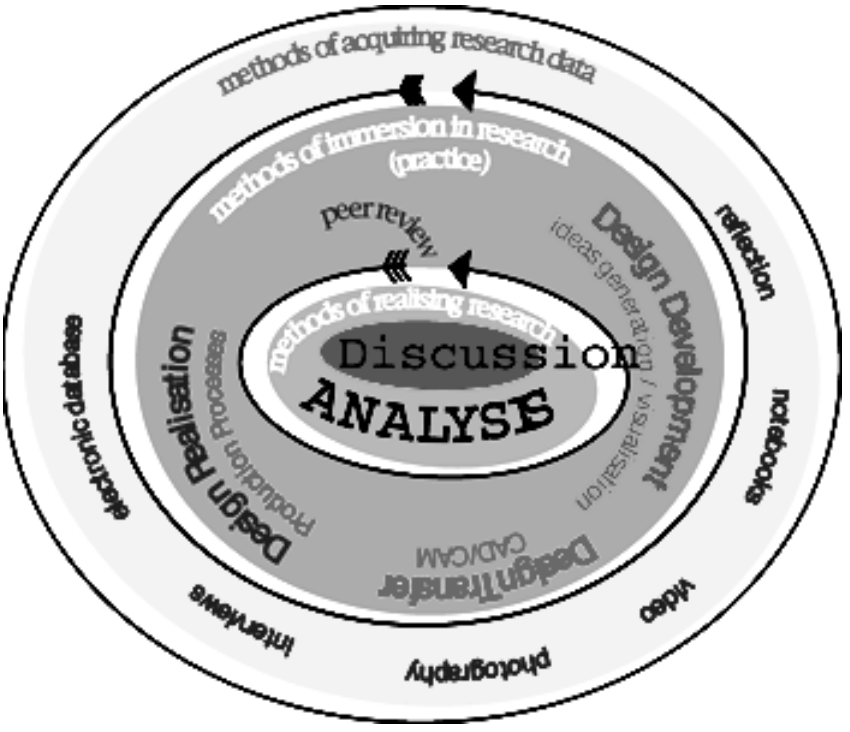

Figure 5.7 Visual overview of analysis using the metaphor of a 'plate'

Bunnell drew on Miles and Huberman's (1994, pp. 10–12) definition of analysis as 'three concurrent flows of activity' – data reduction, data display, and conclusion drawing. She used two 'sieves' or 'filters' – criteria relating to the benefits and limitations of using new technology in designer-maker practice – as a means of reducing the data and bringing some order to it. Concurrent with this she began mapping, grouping and relating the data by means of visual displays. Tentative conclusions as to the effectiveness of integrating new technology into practice were proposed through interrogating the actual body of experimental work. More developed conclusions emerged through concentrating on three different examples of resolved work (Figure 5.8).

Other completed formal research in Art and Design provide examples of different analytical strategies, for example:

- using corroboration between three sets of outcomes – from practice, from student projects, and from 'expert' participation;
- a series of interviews with commissioners/clients, 'expert' designers, users, as well as the designer-researcher's own critical evaluations;
- site-specific artworks as 'cases' involving the feedback of all the participants in the research – architects, users of buildings, commissioners, and the critical analysis of the artist researcher.

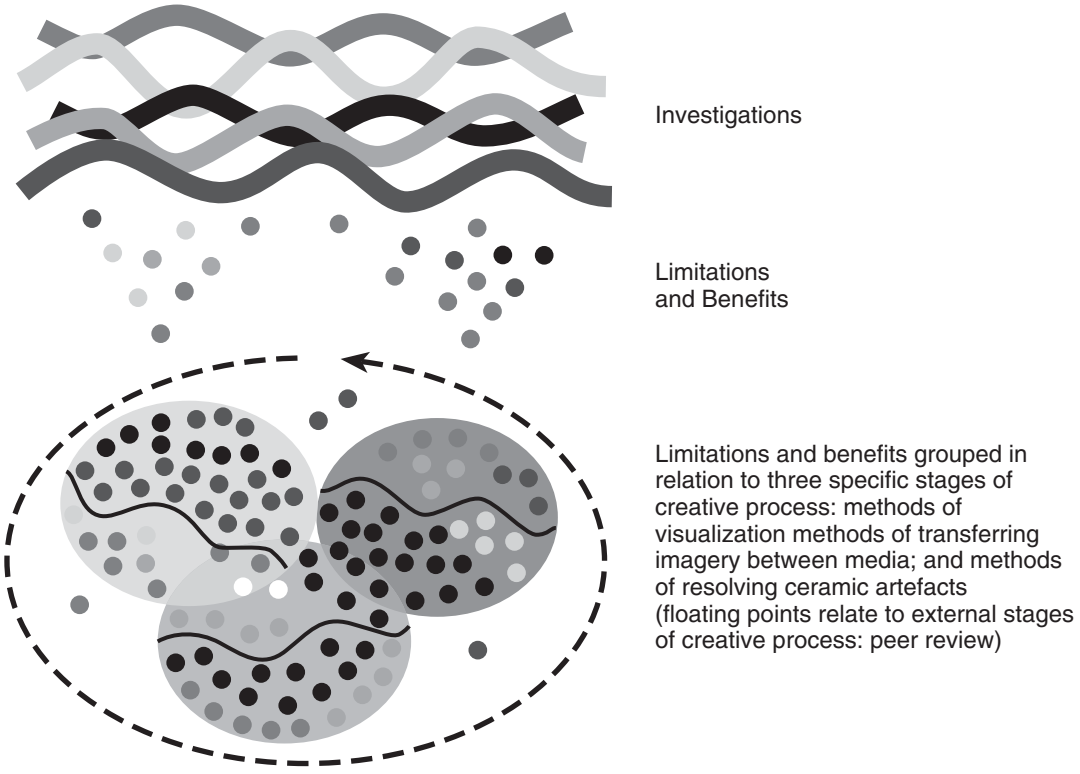

Figure 5.8 Three stages of analysis – filtering, mapping/grouping, and interrogation of the body of work towards conclusions (💻)

Multiple perspectives in analysis

Most of the examples cited demonstrate the use of multiple perspectives in analysis. This is a particularly important methodological consideration. As we saw in Chapters 1 and 3, the use of multiple methods in generating and gathering data offers the opportunity for using triangulation to help get a 'fix' on a complex something in order to understand it more fully by examining it from different perspectives (Figure 5.9).

The different views either come together to support your argument or make you question your original research proposition. Both outcomes are valuable in research terms. Obviously, it is satisfying to have arrived at some kind of consensus or broad agreement; however, it is equally interesting to have a range of different and possibly conflicting views. When dealing with complex, real-world issues, rarely does everything fit neatly and resolve into an elegant whole. Contemporary research practices must be prepared for this and make an interpretation of the research that acknowledges pluralism. An honest appraisal of the strengths and limitations of the analytical approach and methods used is an important part of a research report or dissertation. A rigorous and robust argument can still be made based on the evidence from the research.

Reflection and action: suggestions

- Examine three completed PhDs in order to find out more about different analytical approaches/methods that have been validated. What analytical strategies and specific methods might you adopt/adapt?
- If appropriate, how will you seek the opinions of others in your analysis?
- Look at selected reviews in professional magazines, periodicals, journals, for example *Art Monthly*, *Design Week*, *Crafts*, *Artists Newsletter*, *Blueprint*, *Flash Art*, *Design Journal*, *Wallpaper*, *Architectural Review*, *Digital Creativity*, *Journal of Visual Arts Practice*, and so on. Can you identify different styles of critical analysis in these publications?
- Read Umberto Eco's small book *Reflections on 'The Name of the Rose'*. This provides a superb example of a concise and clear analysis of a much larger work by 'telling the process'.

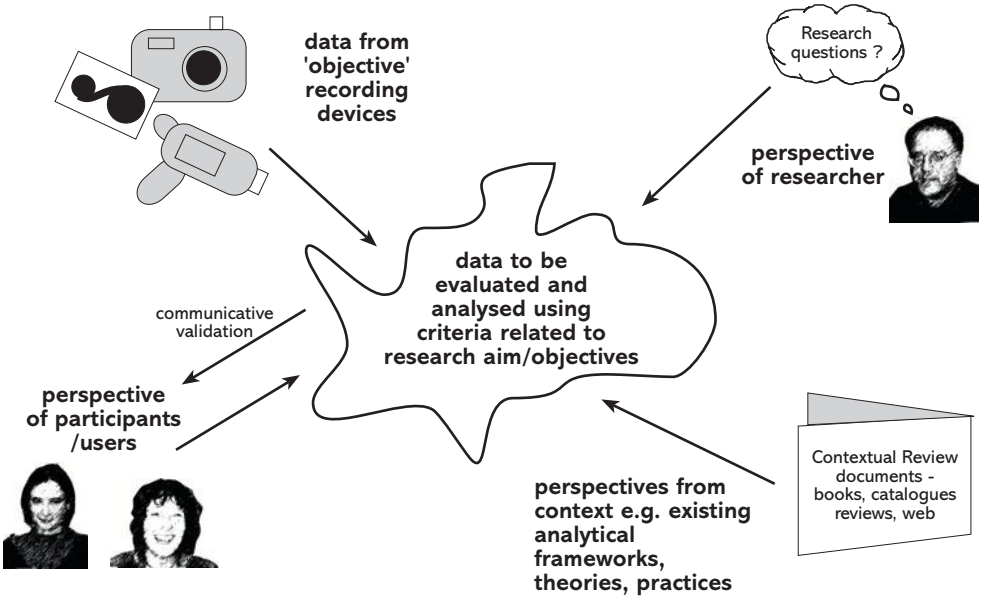

Figure 5.9 'Triangulation' in analysis: the use of multiple and diverse perspectives (💻)

5.3 'PLAYING' WITH DATA: TOOLS FOR ANALYSIS

This topic describes a range of visual structures by which to analyse and make sense of data resulting from the use of research methods. As there are many different analytical approaches, presented here are only the *principles* of various structures for analysis and no detailed content examples. We offer these as 'tools' for possible ways of looking at data, 'playing' with them as a creative activity and finally making sense of them.

Again, these are not comprehensive and not exhaustive. You should seek out other structures/tools in your wider search for examples of analysis.

Useful references on analytical tools

There is a reasonable amount of established literature on analytical structures and techniques, mostly in relation to quantitative data, for example Robson (1993, Section 11) – frequency distribution table, histogram, pie chart, scattergram, chi square, and so on. This topic does not describe these. (For further details read Bryman and Cramer, 1990.) There is a developing body of published work on visual research in the social sciences, for example Sage publications such as *Visual Methodologies* (Rose, 2001); *Visual Methods in Social Research* (Banks, 2001). Whilst any information on visual research methods is welcomed, the emphasis in these books is on sociology, ethnography, cultural studies, semiology, and so on. Although we acknowledge the usefulness of this, what is presented here tries to relate as much as possible to Art and Design research. In our view, some of the best examples of visual analysis are contained in Edward Tufte's three books (all Graphics Press):

- *The Visual Display of Quantitative Data* (1983)
- *Envisioning Information* (1990)
- *Visual Explanations* (1997)

Every page contains excellent examples of visual analysis, some of the principles of which are described here, but we would urge you to consult these before you begin your analysis.

Three key activities in analysis

Miles and Huberman's 'three concurrent flows of activity' in analysis – data reduction, data display, and drawing conclusions from these first two – provide a basic framework for analysis. Within this framework, various structures/tools can be employed:

- data *reduction* – any structures/tools that encourage you to sort, select, focus, order, simplify data; for example, applying criteria – 'spectacles', 'sieves' and 'filters'; coding data by colour highlighting (relating to criteria); condensing, grouping/clustering.
- data *display* – any structures/tools that present data in an organized and usually compressed visual format, so that the user can gain an overview and understanding of the whole – literally, 'see what you might mean'; displays can show links and relationships between concepts/variables, and can bring relevant data together to encourage the drawing of conclusions.
- *drawing conclusions* – once the data are in some kind of display they can be interrogated for example:
    - How many times . . . ?
    - What kinds of patterns . . . ?

- Are themes/clusters apparent . . . ?
- What relationships exist . . . ?
- How does this relate to existing concepts . . . ?

Using the principle of the 'whole being greater than the sum of the parts' the display can be used to 'go beyond the data' – to generate new perceptions/meanings towards generalizing and theorizing. This process of conclusion drawing is tentative and preliminary at the beginning and must remain flexible. Be sceptical. Be prepared to revisit the data and to modify. Structure and re-structure in different forms. Do not get locked into conclusions too early.

As with the application of research methods in your project, it is important to keep track of your analytical process for the purposes of transparency and accountability. You could use a set of trigger questions such as 'what?, why?, how?, when?, where?, who?'. Keep an 'analysis log' as part of a reflective journal.

Some tools

Various kinds of techniques/structures are suggested, for example matrices, mind maps, networks, activity records, flow charts, and so on. The only way to evaluate their appropriateness to your research data is to try them out. If they are not useful for you then adapt or reject them and seek other techniques.

Matrices

Probably one of the most useful visual tools is a matrix, which is capable of conveying a great deal of information in a compressed space (Figure 5.10). The matrix is a very versatile tool for both information management and for analysis. A matrix comprises 'columns' and 'rows', which represents two different dimensions, concepts or sets of information; for example, 'criteria' in relation to 'research data'. Where these two dimensions cross, a new 'cell' of information emerges, for example by interrogating your 'research data' in relation to your 'criteria' you will derive aspects of a 'research outcome'. In designing a matrix we are considering how to 'partition' information and there are usually many different ways to do this (see Miles and Huberman, 1994, Chapter 9).

The matrix can also be a useful device for making comparisons across the data set, for example identifying differences and similarities in research data against one criterion (across rows), and how different criteria generate different research outcomes from the original data (down columns). Summary information can be added to each row and to each column. Equally interesting are the 'gaps', the matrix helps to identify. This may indicate a difficulty or anomaly in the analysis, that further analysis is required, or that the research is incomplete. Colours can also been used to provide another way of coding the information. Different colours might represent different research methods, or different criteria. You need to try out several different dimension labels to see what works best.

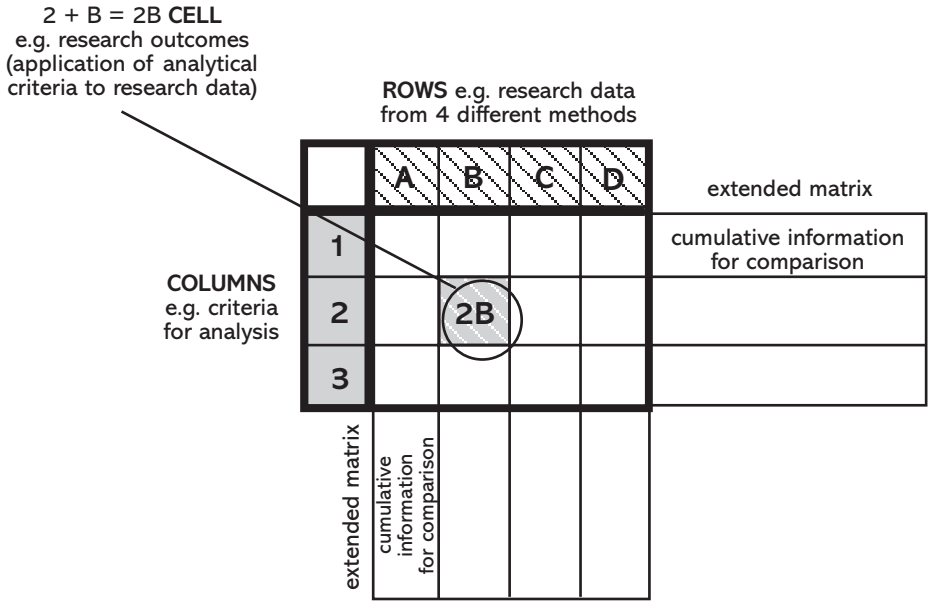

Figure 5.10 A matrix demonstrating some of the features discussed in the text

Mind maps

The ubiquitous mind map is valuable at all stages of the research process, not least in analysis. Whereas usually a matrix can only show the relationship between two variables, a mind map can show a more complex set of relationships. For example, a mind map could be used to interrogate and organize data in relation to the criteria related to your research questions. A map forces you to extract and select from a large amount of data and present your understanding in a single visual. In considering the relationships between keywords on the mind map you may be prompted to rethink how you have dealt with the data. Buzan (1998) provides some good examples of how mind maps can help someone gain an understanding of something and generate meaning from the map, for example the comprehensive visual on organizational structures (Buzan, 1948, p. 262) see also Chapter 4, Section 4.3, Figure 4.3.

Networks

The same kind of concepts used in a matrix can be used in a less rigid structure like a network. A network is a collection of 'nodes' (points) connected by 'links' (lines) and can be visualized as a tree structure with branches or a plant with roots. In analysis network displays are useful for:

- visualizing the relationship between many variables (the extent of the data network),
- visualizing groups and sub-groups (why data 'branches' off, what similarities/differences there are in the data),

- describing an unfolding narrative (presenting a big picture, from which to draw conclusions).

There are many different kinds of network displays, for example context charts, causal networks, hierarchical networks. A good example – a taxonomy of cars and trucks – can be found in Miles and Huberman (1994, p. 133).

Activity records

Many everyday activities can be analysed visually to gain a holistic understanding of any process. For example, in the visual *Activity Record* (Box 5.5, p. 117, Miles and Huberman, 1994), the first impression is of a kind of beautiful wire frame necklace structure – completely symmetrical and delicately constructed. On closer inspection this turns out to be something much more ordinary – a visual analysis of changing a tyre! This kind of activity record can make actions very explicit, indicate important contextual preconditions, identify important phases and reveal the decision-making process. This visual tool could be used in the analysis of making a piece of work for example, or in demonstrating the structure of a particular process.

Flow charts

A flow chart is the classic method of tracking decision making, and seeing the whole picture of that process. An example of this kind of visual tool can be found in Robson (1993, pp. 396–397, Figure 12.3. A flow chart was used to good effect in research on the influence of chance/choice in making sculpture (Figure 5.11).

The chart tracked both decisions and subsequent actions as well as providing an essential record of activity for later analysis. The integration of data into a single display leads to an overview and understanding of a complex process.

A completely different style of flowchart is a multimedia experiment visualizing this kind of decision-making process through animation. In *Dining Out?* (Burt, 2000) you are offered a tantalizing (and humorous) array of choices and all your decisions can be seen at a glance (Figure 5.12).

'Dimensional' analysis

A useful way of sorting out data and generating clusters/groups is to apply some kind of 'dimensional' analysis. The simplest form of this is when two dimensions, say 'function' and 'scale', are crossed (Figure 5.13).

In this example, the portfolio of a contemporary product design company is analysed in relation to the dimensions of 'function' and 'scale'. The resulting analysis space allows for individual pieces of work to be located in relation to these dimensions and a broad brush mapping of the product range to be seen. More detailed structure could be applied to the analysis, for example actual physical measurements of products, a ranking scale for function, and so on. The use of photographs of the products would add to the visual impact of this kind of analysis. The same portfolio could be analysed again using other dimensions, for example 'cost' and 'sales', 'production method (mass or batch)' and 'quality'. More sophisticated analyses could be achieved by combining three dimensions,

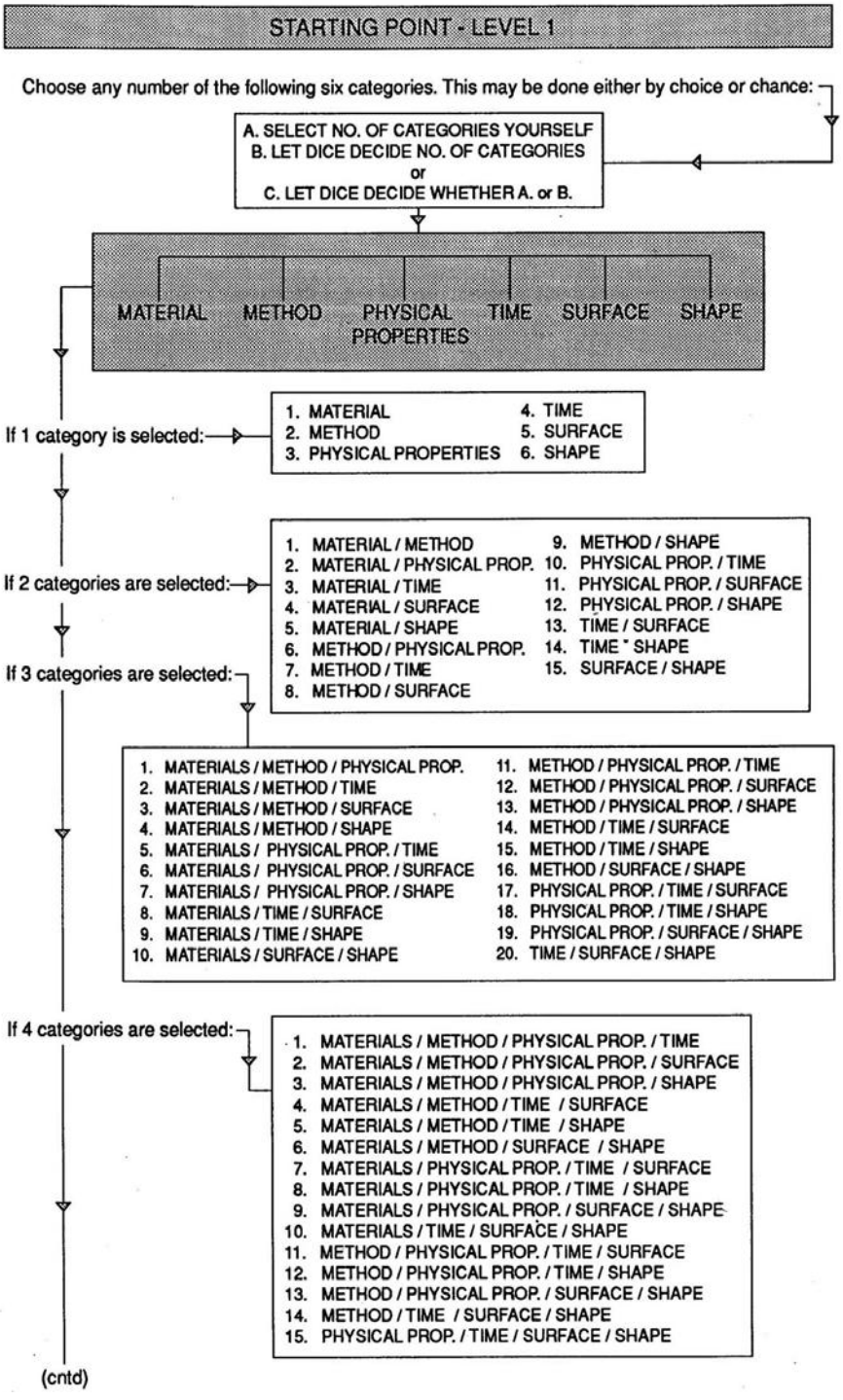

Figure 5.11 Example of a flow chart (Watson, 1992)

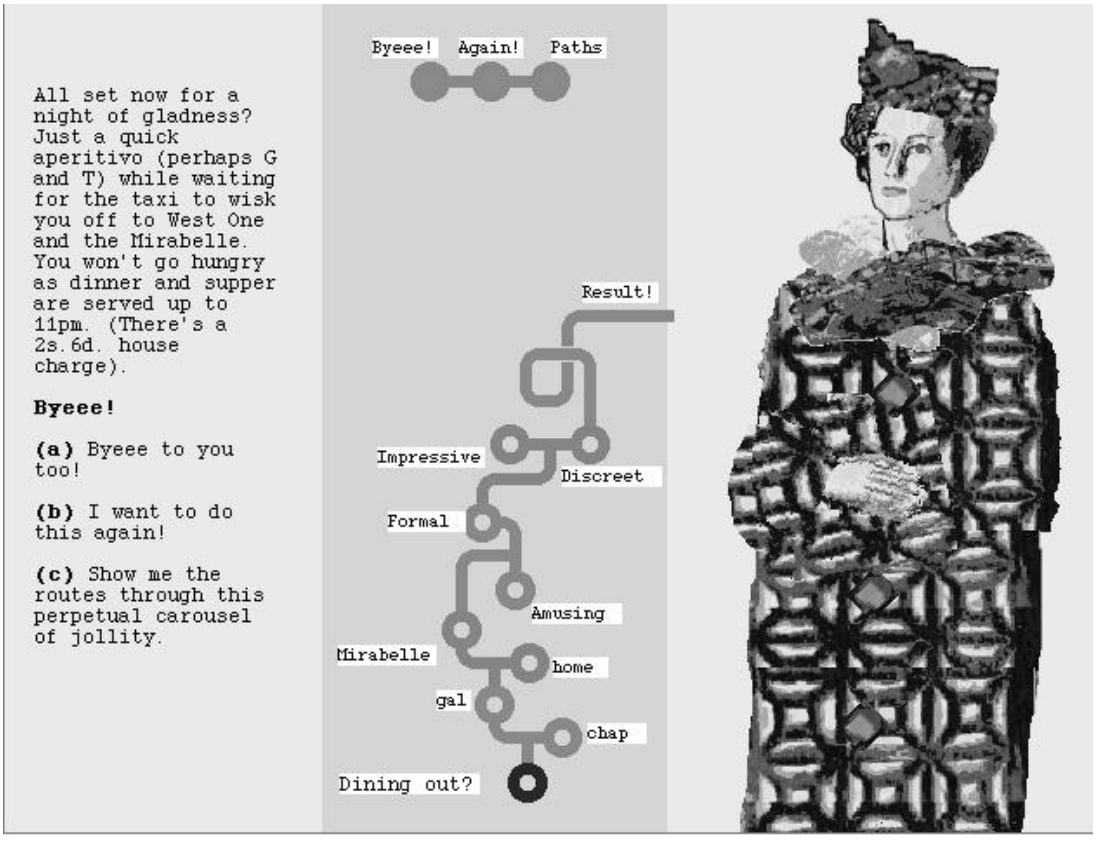

Figure 5.12 A frame from the animated flow chart Dining Out? (💻)

for example function, scale, production method. This technique encourages you to view data from different perspectives, enhancing greater understanding.

Chronological analysis

In the multimedia example, 'Visual analysis of air pollution' the effect of air pollution on humans is analysed and compellingly animated (Burt, 2000 – visit the book's website) see Figure 5.14.

In the main interface, the central large face has descriptions of the variables used in the analysis of air quality, for example the nose shape, scale and orientation represents the level of sulphur dioxide in the air. By moving to any of the 24 outer faces the effect on humans of the whole set of pollutant variables can be seen at any particular hour of the day. The pollution effects are obvious by the expressions on the faces. This animation has been developed from a static visual based on an original data set that was probably completely numeric – a matrix of variables over time (Barnett, 1981, pp. 258–259). The animation is an excellent example of how an interactive visual can bring to life analysis and generate meaning directly related to our own experiences.

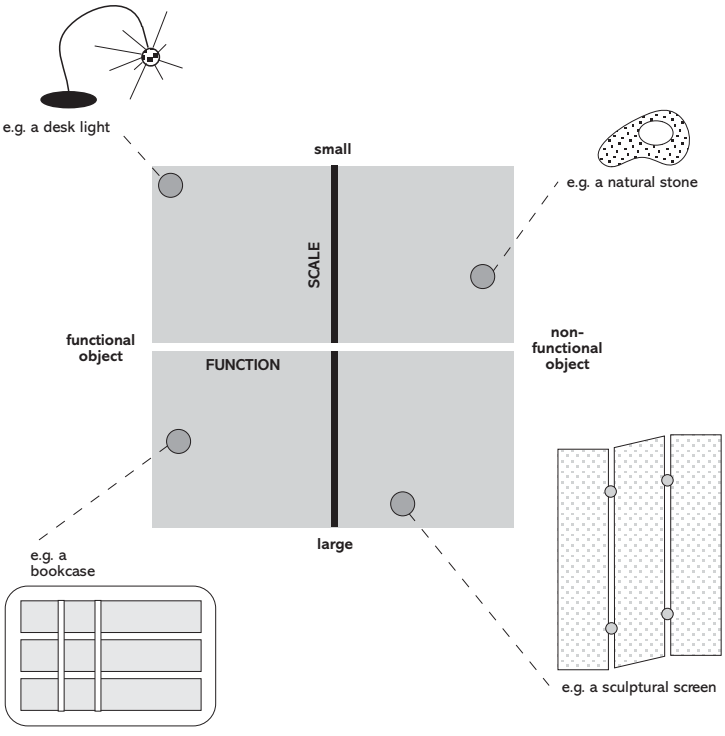

Figure 5.13 Example of a simple dimensional analysis structure

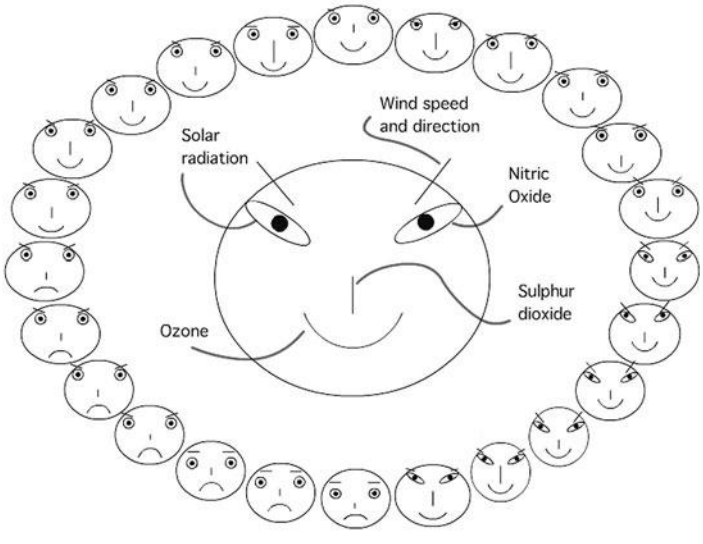

Figure 5.14 Visual analysis of air pollution (💻)

Another interesting visual example can be found in Tufte (1997, pp. 18–19) – an analysis of Giacometti's figurative sculpture in terms of his experimentation with scale and form over time. Actual photographs of the works are displayed as a sequence demonstrating a general shift over time from linear elongated forms to more volumetric ones. This is an interesting way of presenting and analysing a body of work and its developments over time in relation to specific criteria.

Similarly, the development of a designed product can be analysed and visually presented. In Figure 5.15 the process of rapid prototyping is documented and analysed over time and in relation to the 'growth' through layering material in the production of a cup (Burnett, 1999). This analysis helps us to understand the development process involved in using rapid prototyping technology, which turns out to be not so rapid!

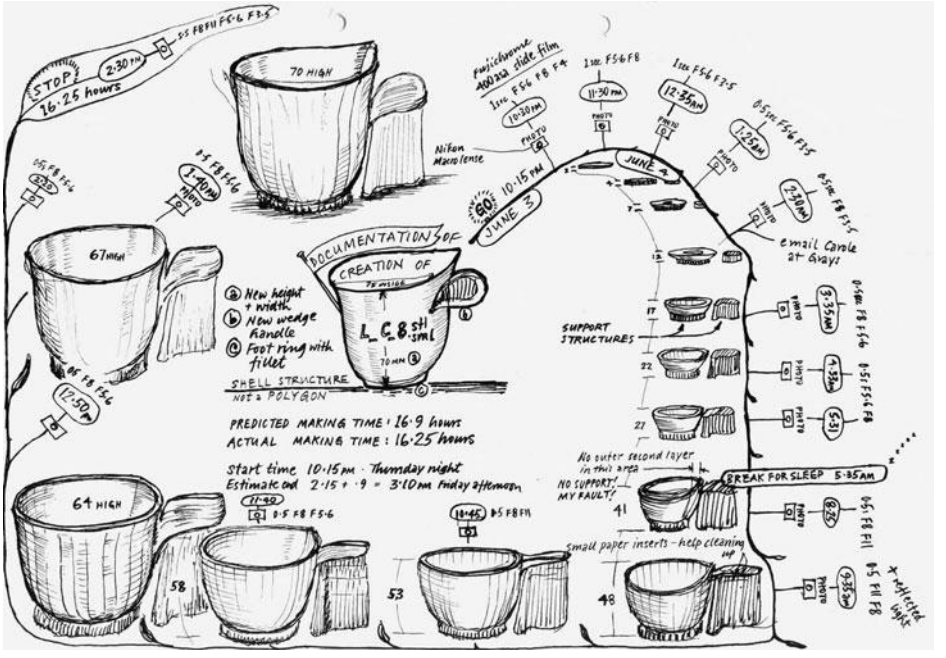

Figure 5.15 Analysis of a digitally crafted object (💻)

Analysis of physical and social environments

Zeisel (1984) provides some good visual examples of the analysis of various environments and how people behave in them. For example, using photographs of a swimming pool and its surroundings (Zeisel, 1984, p. 125) he interrogates the situation by asking:

- what is the physical setting?
- what is the socio-cultural context?
- who are involved?
- what are they doing? with whom?
- what are the relationships between the people in the setting?

The photographs are then annotated with text accordingly, and an understanding of the situation developed. Zeisel (1984, pp. 97, 209) also provides examples of juxtaposed visuals and text in the analysis of architectural space usage. This juxtapositioning allows us to 'see' what we 'mean'. (See also Figure 4.4 for an example of an annotated photograph.)

Analysis of a reflective journal/development log

A reflective journal can become an unwieldy research document! In order to reduce data, display them and make sense of them, an 'elongated' matrix structure can be helpful. In Figure 5.16 the matrix describes 'content of activity' in relation to 'time'. A 'diary' section provides regular extracts in descriptive detail; a 'documentation' section includes visuals of a developing body of work; a 'context' section makes sure that the development is related to the wider professional arena; there is some (intuitive) indication of 'pace' – how the work is progressing (or not!); the most important section is 'analysis', where key points are extracted from the whole experience week by week in order for interim conclusions to be drawn.

An excellent example of yet another kind of extended diary is the 'cyclogram' that describes the space flight of Salyut 6 from December 1977 to March 1978. This beautiful visual can be found in Tufte's (1997, pp. 92–95) *Visual Explanations*. The 'cyclogram' serves as both a log of daily activity during the flight and also a visual analytical record

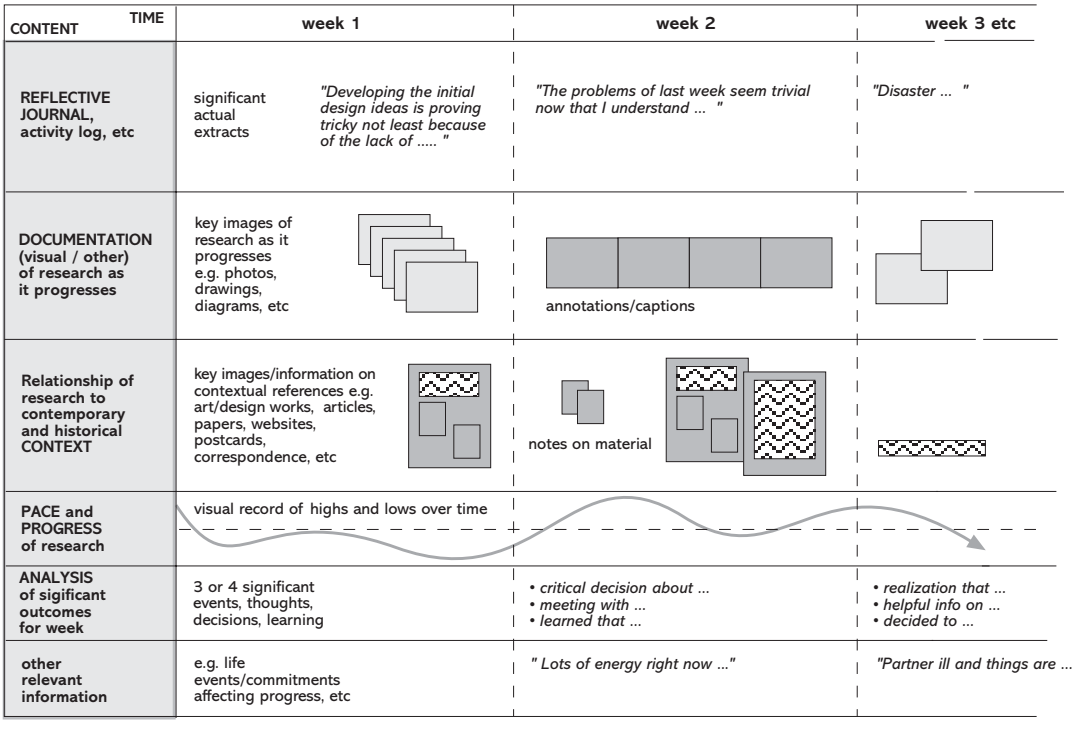

Figure 5.16 Suggested chronological matrix for the analysis of a reflective journal

post flight. The integration of various kinds of data, for example experimental work, dockings with other craft, orbit tracking, nutritional information, and so on, into a single display provides us with an overview and understanding of the whole experience in a way that a textual version might not.

Metaphor and analogy as analytical and interpretative tools

Metaphor

A metaphor is a figure of rhetoric – an implied comparison between two things of unlike nature that yet have something in common. Metaphors convey or create shared meaning. In analysis, the use of metaphor can provide a valuable way of thinking about and interpreting data. Coffey and Atkinson (1996) suggest that:

> Metaphors are a figurative use of language, a ubiquitous feature of a culture's or an individual's thinking and discourse. This is accomplished through comparison or analogy. At its simplest, a metaphor is a device of representation through which new meaning may be learned. At their simplest, metaphors illustrate the likeness (or unlikeness) of two [things]. A metaphorical statement reduces two [things] to their shared characteristics. (Coffey and Atkinson, 1996, Chapter 4, p. 85, text italics in brackets by authors)

In Chapter 3 we described the role of metaphor in problem setting in product development – paintbrush as pump (Schön, 1993). By seeing the paintbrush as a pump – two basically different things – they were using a metaphor as a way of generating new questions and new solutions. This process of 'generative metaphor' is a useful analytical strategy. In being asked to consider the paintbrush as a kind of pump, the product developers were forced into asking the question 'how could that be?' (and finding reasons), 'in what ways are they similar and different?' (thereby making comparisons and contrasts), 'how does this help us to take new approaches to the problem?' (being inventive). They were forced to 're-group' and 're-name' elements of the paintbrush, so that it could be seen as a pump – essentially making a new interpretation.

Schön (1983, p. 78) also gives us another example in describing design as a 'conversation', where design is considered as a dialogue between the designer and her work. By considering this metaphor, we can ask questions related to the process, for example 'what kinds of things happen in a conversation'? Through this we can develop an interpretation and understanding of the design process.

In David Lodge's (1988) novel 'Nice Work' the female protagonist – an English language lecturer – performs a semiotic analysis of a famous cigarette advertisement, providing an excellent example of how the use of metaphor can be used to uncover complex layers of meaning.

Analogy

The use of analogy is also helpful in trying to articulate something that is not fully understood. In the first stages of analysis we usually cannot see the 'whole' only the parts. For instance, in the Hindu story of the blind men and the elephant, analogy was used to describe the various parts of a large complex thing. 'It's like a snake, . . . a fan, .

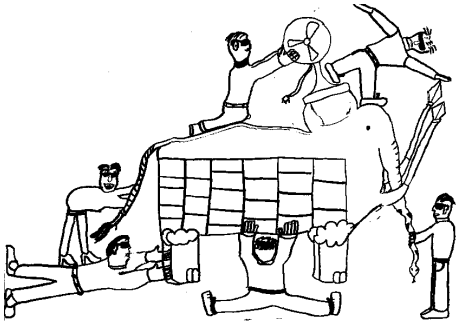

Figure 5.17 Research is . . . like an elephant

. . . a wall, . . . a rope' (Gray, 1998) (Figure 5.17). We are seeking an interpretation of usually a complex thing, difficult to comprehend as a whole, but which may be understandable by analogy in parts.

There are three basic types of analogy:

(1) *Direct analogy*
This is where a situation exists that directly parallels the situation you are investigating. For example, it may be the decline of traditional craft-based businesses. Are there analogies with other industries? Perhaps similar economic pressures or social trends are relevant.

(2) *Biological analogy*
This is where an example drawn from the natural world can be used to provide a model. For example, the branching structure of trees helps describe some hierarchical organizations, whereas others are more like neural networks.

(3) *Personal analogy*
These are somewhat more difficult to picture. In this case, the idea is to imagine yourself as part of the situation under investigation. For example, considering organizational structures again, can you picture yourself as the organization. It may be healthy or ailing. It may require a new set of clothes or a complete make over. Given any situation, how would you deal with it? Can you find a personal analogy that relates to your own area of interest? One way of using analogies is to see them as examples or parallel situations that can be used to suggest new solutions. The use of analogies in the research context is intended both as a method of generating ideas and as new ways of examining your data for analysis and creating an interpretation.

Creative construction: making sense, making meaning

From the previous topics we have seen that analysis is considered as a creative engaging activity – indeed Miles and Huberman (1994, p. 1) go as far as to claim that 'Qualitative data are sexy' leading to 'serendipitous findings and to new integrations'. We have also seen examples of how researchers in Art and Design have tried to use their visual/haptic

skills and knowledge to make sense of their research and derive their own interpretations and meaning. Finally, we have encouraged you to 'play' with your data – not in any superficial sense or without serious research intent – but as a way of becoming so familiar with it that you can explore its possibilities and limitations, using various tools, as a way of making sense of it, and ultimately making meaning.

Now we attempt to draw parallels between analysis as a creative construction in the research process and making sense and meaning through the generic creative development of an art/design work. It is offered as a playful observation – one interpretation.

As practitioners in Art and Design, we are at some point involved in 'making', whether in response to a design brief or a more individual means of artistic expression. We usually start with some kind of curiosity. From this stage we might develop an intention (proposition, vision) and imagine the possible ways forward. Depending on our working preferences we might start sketching (testing, shaping) some ideas in two, three or more dimensions. This 'visual thinking' usually involves putting elements together (construction, assemblage, combination) and taking elements apart (deconstruction, separation, isolation). We are concerned with relationships, contrasts, comparisons, patterns – the parts in relation to the whole.

At this stage, we probably don't want to commit to anything too soon – a process of considering various options and alternatives – and things are possibly quite quickly loosely or temporarily connected, so that we can easily take them apart. We are continuously reflecting and evaluating – cross checking against our original intention to see how far we are progressing. It is a process of trial and error – 'let's see if this works . . . ', 'what if . . . '. The strategy is playful – we suspend belief for a moment and just try it. We are continually testing the limits. Things 'fail', things don't fit, things fall apart. Back to the drawing board!

With time, things start to come together – a gradual malleable coherence. We may begin to model this softness into different shapes. This can be both additive and reductive. We may try moulding the material against a given or containing form to see what impressions we get. As ideas cohere they might solidify into a clearly defined form. Yet this might still be open to question and we might carve back into it – paring away to essentials, to essence – to sense.

It's time to commit! Things are never perfect, never totally resolved. We never quite achieve our vision. But there is value in drawing the line, drawing out, drawing conclusions – presenting what we think just now makes sense to us and communicates as much of our original intention to others in a meaningful way.

And so with the process of analysis – it is a creative construction.

Reflection and action: suggestions

- What tools do you think will be useful for your analysis and why?
- Find some examples of different kinds of visual analysis relevant to your research.
- What metaphors and analogies might you use in your analysis and why?
- Think about your own practice – describe your approach to 'creative construction'.

Looking back on Chapter 5: Interpreting the map

In having crossed the terrain, we have now hopefully reached some higher ground – a vantage point from which we can look down on where we have been as well as gain a much closer view of our destination. We need to review and evaluate the quality and trustworthiness of all our evidence. Through the use of various kinds of spectacles and sieves (criteria for analysis) we can begin to select, focus, filter and distil significant material to address our research questions.

To help us in this task we can learn from the analyses and reported outcomes of other explorers. What analytical approaches, frameworks and methods have they used? How have they visualized and made explicit their analyses? Has feedback from multiple perspectives been sought so that different views can be considered? All the while we must acknowledge the strengths and limitations of any analytical strategy that informs ours.

Analysis has been described as 'imaginative, artful, flexible and reflective' – an iterative and cyclical process. The notion of 'playing' with data, being immersed in it, creatively involved with it, using data to think with is especially engaging. A range of 'tools' and techniques for this – some simple and visual, others more complex and discursive – can be used to explore and interrogate the research evidence in different ways.

Eventually, however, the provocative 'so what?' presents itself and challenges us to make sense of our journey of exploration. The creative construction of a convincing argument drawing on robust evidence, must be made. We draw out, shape, model, carve, cast, mould, weld. Make a point, underline. We reach a plane of understanding. We offer a mass of solid argument. We make an interpretation – our own map. We make new meaning.

REFERENCES AND FURTHER READING FOR CHAPTER 5

References

Banks, M. (2001) *Visual Methods in Social Research* (London: Sage).

Barnett, V. (1981) *Interpreting Multivariate Data* (Chichester: Wiley).

Bauer, M.W. and Gaskell, G. (eds) (2000) *Qualitative Researching with Text, Image and Sound: a Practical Handbook* (London: Sage).

Bryman, A. and Cramer, D. (1990) *Quantitative Data Analysis for Social Scientists* (London: Routledge).

Bunnell, K. (1998) *The Integration of New Technology into Designer-maker Ceramic Practice*. PhD thesis, The Robert Gordon University.

Burnett, G. in collaboration with Birch, T. (1999) Australian cultural issues re-defined by digitally crafted domestic objects. *Exhibition Catalogue* (Monash University and The Robert Gordon University).

Burt, I. (2000) *The Use of Multimedia for Practitioners in Art and Design*. PhD thesis (on CD-ROM) The Robert Gordon University.

Buzan, T. (1998) *The Mind Map Book* (London: BBC Books).
Coffey, A. and Atkinson, P. (1996) *Making Sense of Qualitative Data: Complementary Research Strategies*, Chapter 1 (Thousand Oaks, CA: Sage).
Csikszentmihalyi, M., Getzels, J. W. and Kahn, S. P. (1976) *The Creative Vision: A Longitudinal Study of Problem-finding in Art* (Chichester: Wiley).
Douglas, A. (1992) *Structure and Improvisation: The Making Aspect of Sculpture*. PhD thesis, Sunderland University.
Douglas, A. (1997) On the notion of test (multimedia essay on CD ROM) in: S. Evans, J. Greenhill and I. Svenson, *Matrix 3D: Sculpture, Method, Research* (London: Lethaby Press).
Eco, U. (1985) *Reflections on 'The Name of the Rose'* (London: Secker & Warburg) (translated from the Italian by William Weaver).
Gray, C. (1988) *Teaching styles in Higher Art Education*. PhD thesis, Aberdeen University.
Gray, C. (1998) Inquiry through practice: developing appropriate strategies, in: *No Guru, No Method? Discussions on Art and Design Research* (Helsinki: University of Art & Design).
Lincoln, Y. and Guba, E. (1985) Naturalistic Inquiry (Thousand Oaks, CA: Sage).
Lodge, D. (1988) *Nice Work* (London: Secker & Warburg).
Miles, M. B. and Huberman, A. M. (1994) *Qualitative Data Analysis*, Chapter 9, Matrix displays: some rules of thumb (Thousand Oaks, CA: Sage).
Packer, M. J. (1985) Hermeneutic inquiry in the study of human conduct, *American Psychologist*, 40(10), pp. 1081–1093.
Robson, C. (1993) *Real World Research: a Resource for Social Scientists and Practitioner-Researchers*, Section 12, pp. 370–407 (Oxford: Blackwell).
Rose, G. (2001) *Visual Methodologies* (London: Sage).
Schön, D. (1993) Generative metaphor: a perspective on problem-setting in social policy, in: A. Ortony, *Metaphor and Thought*, Chapter 9 (Cambridge University Press).
Silver, S. (1999) *The Roles of Artists in the Public Realm: an Investigation into Artists' Generative Processes in Context*. PhD thesis, The Robert Gordon University.
Tesch, R. (1990) *Qualitative Research: Analysis Types and Software Tools*, pp. 77–111 (Basingstoke: Falmer).
Tufte, E. (1987) *The Visual Display of Quantitative Data* (Cheshire, Connecticut: Graphics Press).
Tufte, E. (1990) *Envisioning Information* (Cheshire, Connecticut: Graphics Press).
Tufte, E. (1997) *Visual Explanations* (Cheshire, Connecticut: Graphics Press).
Watson, A. (1992) *An Exploration of the Principle of Chance as a Stimulus to the Creative Activity known as Sculpture*. PhD thesis, The Robert Gordon University.
Zeisel, J. (1984) *Inquiry by Design* (Cambridge, UK: Cambridge University Press).

Suggested further reading

Booth, W. C., Colomb, G. G. and Williams, J. M. (1995) *The Craft of Research* (Chicago: University of Chicago Press).
Cage, J. (1961) *Composition as Process* (Massachusetts Institute of Technology).

Cohen, L. and Manion, L. (1994) *Research Methods in Education* (London: Routledge).
Research Training Initiative (1996) *Research Perspectives in Art & Design: Case Studies* (Birmingham Institute of Art & Design, University of Central England) http://www.biad.uce.ac.uk/research/index.html.
Van Leeuwen, T. and Jewitt, C. (2000) *Handbook of Visual Analysis* (London: Sage).

NOTES

1. For further details see Robson, (1993, pp. 66–75, 402–407); see also Miles and Huberman (1994, pp. 277–280) for a useful set of questions you can ask of your research in order to describe and confirm its quality.
2. Published sources include:
   Tesch, R. (1990) *Qualitative Research: Analysis Types and Software Tools*, section: 'Types of Qualitative Analysis' pp. 77–11 (Falmer).
   Bauer, M. W. and Gaskell, G. (eds) (2000) *Qualitative Researching with Text, Image and Sound: A Practical Handbook* (Sage).