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VISUALIZING RESEARCH

A GUIDE TO THE RESEARCH PROCESS IN ART AND DESIGN

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1.2 THE RESEARCH PROCESS – WHAT? WHY? HOW? SO WHAT?

Research is a process of accessible disciplined inquiry. The process described here is essentially generic but should be framed and customized by your particular discipline and subject area. The process is usually shaped by three apparently simple questions:

- 'what?' – the identification of a 'hunch' or tentative research proposition, leading eventually to a defined and viable research question
- 'why?' – the need for your research in relation to the wider context, in order to test out the value of your proposition, locate your research position, and explore a range of research strategies
- 'how?' – the importance of developing an appropriate methodology and specific methods for gathering and generating information relevant to your research question, and evaluating, analysing and interpreting research evidence.

A fourth question – the provocative 'so what?' – challenges you to think about the significance and value of your research contribution, not only to your practice but to the wider research context, and how this is best communicated and disseminated.

Although the stages are presented here in a numbered sequence for clarity's sake (Figure 1.1), in reality they are part of a continuous iterative cycle, or helix, of experience (consistent with Kolb's 1984, 'experiential learning cycle'). Stages can be revisited several times, and usually some are concurrent with others, for example, reflection, evaluation and analysis are ongoing activities at every stage (see Orna and Stevens, 1995, chapter 1, pp. 9–12). Be prepared to be flexible and responsive to your research situation. Each stage in this overview is expanded upon in subsequent chapters.

Key stages of the process

What might you research?

Stage 1. We have seen from the 'travellers' tales' that ideas for research can emerge from a vague but nagging hunch, a personal dissatisfaction, or some other issue within creative practices identified by the practitioner. Alternatively, there may be a professional stimulus to which the practitioner must respond creatively in order to survive and thrive, for example new approaches to practice in response to cultural, social economic, or environmental challenges. Whatever the initial impetus, the 'what' should come from a genuine desire to find something out, or else it is unlikely that the study or the enthusiasm for it will be sustained.

Why is your research needed?

Stage 2. You should consider whether your idea really could be developed into a viable research topic that needs researching. Usually there is a good personal reason for undertaking the research – especially issues relating to practice – but is there a wider need and can this be confirmed?

Stage 3. You will need to make an initial search for information that supports your hunch (research proposition) and ideally suggests that research is required. It is important to get some feedback on this from your peers and others in professional and research contexts. Gather some background information on your research proposition and its ethical implications.

Stage 4. If there is no apparent external rationale for the research then it could be considered too much of an indulgent and idiosyncratic idea for a research project. You could stop now!

Stage 5. More positively, you could refocus your initial proposal in response to what you have so far discovered. You may have identified research that is similar, or even identical, to what you are proposing. In this case there is no point in reinventing the wheel! The chances are that this completed research has raised new questions to be answered. This gives you a real opportunity and a firm basis from which to develop your own particular research proposal.

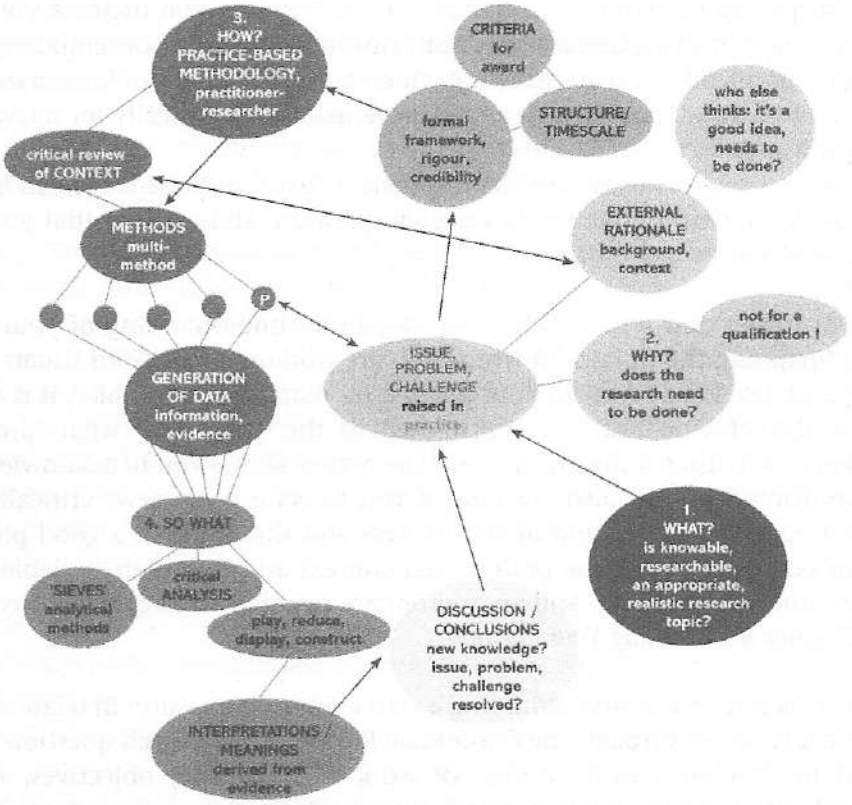

Figure 1.1 The Research Process – important issues to be considered at the start of the research

These preliminary stages are extremely important in 'planning your journey' and beginning to identify and formulate a research question and a suitable research strategy (this is covered in detail in Chapter 3 – Locating Your Position). In 'planning the journey' it is crucial to have some idea of where you want to go and why. Also, you should take advantage of the knowledge of explorers who have visited similar areas. Research is a journey of exploration through which individuals can make small but significant contributions to understanding the landscape of research in Art and Design.

The next stages in the research process usually involve finding already completed research in the public domain, and using this knowledge to help situate yourself as a researcher and focus your research question. In traditional research terms, this kind of survey and evaluation would be called a 'literature review'. Increasingly, information exists in a wide range of media, for example in digital formats on the web, as documented events/exhibitions, and not simply in paper-based 'literature'. Therefore, the term '*contextual review*' is used to encompass all kinds of information in different media in the public domain (this is covered in detail in Chapter 2 – *Mapping The Terrain*).

Stage 6. The contextual survey and review is an essential process for several reasons:

(a) by surveying the context in which you are working you increase your understanding of it in a general sense, both historically and in contemporary terms;
(b) more specifically, you are selecting which particular pieces of information relate directly to your research area and can evaluate them critically for relevance and significance;
(c) in the process of survey and critical review, 'gaps' in knowledge can be identified, which help to focus your research question, and confirm that you are not likely to reinvent the wheel!

This stage of survey and review helps you to gain an understanding of your research context by 'mapping the terrain' in which you are working. It helps to situate you as a researcher, and develop a focus for your project. In 'mapping the terrain', it is crucial to have some idea of who else has contributed to the 'map' and what 'projections' (perspectives and methods) they have used. The review allows you to acknowledge their different contributions, but also encourages you to state your views critically – both positive and negative! At the end of this process you should be in a good position to 'locate your position' within the professional context and formulate a viable research question in 'uncharted terrain' and an appropriate research strategy (this is covered in detail in Chapter 3 – *Locating Your Position*).

Stage 7. This stage concerns identifying a viable research question in relation to what you have discovered through the Contextual Review. The research question can then be used to develop a realistic plan of work with an aim, objectives, rationale, methodology, projected outcomes and outputs. Most research questions will raise some ethical issues. These should be considered in relation to the design of the research project (more on this in Chapter 3).

How might you do research?

The next phase of the research process is very much an active one! So far you have 'planned the journey', 'mapped the terrain' and 'located your position' in it. Now you will set off across that landscape on a journey of discovery – 'crossing the terrain' (this is covered in detail in Chapter 4).

Stage 8. First of all you need to consider which modes of transport – that is, methodology and methods – you will use. This depends on the terrain. It is important to consider initially a wide range of options, to examine some useful examples, and perhaps try a few out (as pilot studies). You might adopt a methodology in which your practice, or aspects of it, may play a role in the investigation. You might need to use several methods – a multi-method strategy – in which two or more methods are used to address your research question. This is a kind of 'triangulation' of methods. Your research methods must be used rigorously in order to yield good quality evidence. This stage might require you to test out the ground before venturing onto it, to retrace your steps, to use more than one vehicle, to go off in different directions, to explore many kinds of terrain, to collect a range of data in order to begin to provide enough evidence to be in a position to address your research question. It is important to document your whole journey – you might keep a reflective journal to record your progress. It is important to carefully organize and manage the information you amass so none is lost on the way.

Having actively explored the terrain, the next stage concerns evaluation and analysis – 'interpreting the map' (this is covered in detail in Chapter 5).

Stage 9. The material you have gathered in crossing the terrain provides evidence for questioning and, hopefully, substantiating your research proposition. Keeping an open mind, you need to reflect on your experiences and the collected information. You need to evaluate and select – what's valuable, relevant, significant, and what isn't? You need to 'sieve' the material using criteria derived from your research objectives. You need to 'play with the data', visualizing possibilities, making creative connections. You sometimes need to take things apart to understand them and then put them back together, perhaps in a different way, in order to make sense and develop meaning. From this analysis you should arrive at an interpretation of your research evidence.

So what?

The final stage of the research process concerns the critical synthesis of the whole experience, demonstrating its value and significance through effective communication and dissemination – 'recounting the journey' (this is covered in detail in Chapter 6).

Stage 10. By this stage you should be in a position to make a conclusion about what you have discovered and its value and significance to the wider research context. At PhD level this should be a new contribution to knowledge. At Masters levels you

should be able to demonstrate a critical evaluation of your research context and show that you have an understanding of methodological issues. Your research findings need to be made 'accessible' and presented in a variety of imaginative ways. The thesis – your argument – may comprise several complementary but coherent elements – a body of work, a written text, other supporting material in various formats. It will be necessary to 'defend' your argument – especially for a research degree – in an examination viva. An important part of any thesis is the identification of future research leading on from your work. This brings the research process full cycle – the identification of new research questions and new territory to be explored.

We might therefore conclude that research in Art and Design should:

- be required and relevant – have clear external, professional and personal rationales for the need for the research;
- be intentional – it is envisioned, proposed, prepared for, strategically planned and focused;
- be disciplined – be rigorous, critical and ordered (but not necessarily systematic in the scientific sense) – it is a structured investigation;
- develop a research approach which acknowledges practice as:
  - an initiator of the research questions, which are usually complex and 'messy',
  - providing the context for the research,
  - playing a part in the research methodology and in developing innovative and creative, but nonetheless rigorous, research methods,
  - imaginatively making visible/tangible the research findings,
- be revelatory – contributing alternative and/or new perspectives and insights
- be public – the whole process and its outcomes are open to scrutiny and possible future use by others.

Having an initial strategic view of the whole process helps to you to imagine and visualize the development of your own research project and to start to plan your journey.

Reflection and action: suggestions

- The research process is described as 'iterative'. Make your own visualizations of the key stages using cyclical/helical structures, or some other structures relevant to your preferred learning style.
- We have used the metaphor of 'journey of exploration' to visualize the research process. What other metaphors might be relevant for your research?

1.3 A ROUTE MAP: THE IMPORTANCE OF METHODOLOGY

This section describes the importance of knowing how to research. It provides some definitions of 'methodology' and 'method', and describes different philosophical posi-

tions in research – research paradigms. It proposes what might be the developing characteristics of a more 'artistic' research methodology.

Fishing

If research is a process, then learning about research is about learning *how* to research. We could almost say that the process is more important than the product – the journey is more interesting than the destination. Knowing how to research is perhaps much more valuable than finding out a particular thing, gaining a particular piece of knowledge, particularly as 'Knowledge keeps as well as fish!' (anon.). All knowledge is tentative. Today's knowledge is tomorrow's joke – the earth is the centre of the universe and is flat! If knowledge has a sell-by date, then the most important thing is meta-knowledge – knowing about knowledge, knowing how to acquire, manage, analyse, synthesize and communicate knowledge. Research is about searching for alternatives. Being sceptical and critical are crucial research characteristics in progressing from one piece of knowledge to a better, more 'fit' version. If we accept the 'fish' argument then 'fishing' – knowing *how* to do research, knowing about methodology – is perhaps the most important part of the research process.

> 'Use your methodology to discipline your passion, not to deaden it.' (Rose, 2001, p. 4)

The terms **'methodology'** and **'method'** are often abused and sometimes used interchangeably, but there is a distinct difference.

> *Method*:
> 1. 'a way of proceeding or doing something, especially a systematic or regular one';
> 2. 'orderliness of thought, action, etc';
> 3. '(often plural) the techniques or arrangement of work for a particular field or subject'. (New Collins Concise Dictionary, 1986)

Methods are specific techniques and tools for exploring, gathering and analysing information, for example observation, drawing, concept mapping, photography, video, audio, case study, visual diary, models, interviews, surveys, and so on.

Methodology is the study of 'the system of methods and principles used in a particular discipline' (New Collins Concise Dictionary, 1986).

> The comparative study of method presumes that some methods exist, but methodology implies no choice among existing methods. The situation is quite the contrary. Methodological sophistication leads to appropriate choices among methods. It can also lead researchers to develop and apply new methods. (Friedman, 2002)

Only through investigating and comparing different research approaches and the various methods used are we enabled to make an informed decision about how to proceed. The aim of methodology is to help us understand, in the broadest possible terms, not the products of inquiry, but the process itself:

1.4 THE 'REFLECTIVE PRACTITIONER'

Reflective practice

The 'reflective practitioner', 'reflective practice' and 'reflection in action', are important concepts for artists and designers engaging in research. The concepts derive from Donald Schön (1983) and are the focus of his book, *The Reflective Practitioner: How Professionals Think in Action*. The subtitle is telling. The book is an exploration of how professional practitioners in a range of disciplines (design, planning, management, psychotherapy) think and act – how they set problems and solve them in real world professional contexts. Schön proposes that much of this activity is personal knowledge, not usually articulated, sometimes indescribable, and that it relies on improvisation learned in practice. In fact he likens it to an intuitive 'art' – 'knowing-in-action, the characteristic mode of ordinary practical knowledge'. This kind of 'knowing' is dynamic – knowing *how* rather than knowing what. Schön identifies that the professional's inability or unwillingness to articulate this kind of knowledge has led to a separation of academic and professional practice. This sounds familiar – much of the debate about research in our sector has focused on the fear of losing creativity by speaking about it, and even worse, by writing about it!

One of the consequences of this separation has been that research *about* (into) practice has tended to be carried out by other academic researchers (historians, educationalists, sociologists, psychologists, and so on) from an external perspective. These approaches reflect more the classic scientific method, where the researchable is objectified, and the researcher remains detached. A reliance on others to carry out research could undermine the development of a research base within our sector. Schön points the way forward:

> . . . when we reject the traditional view of professional knowledge, recognising that practitioners may become reflective researchers in situations of uncertainty, instability, uniqueness, and conflict, we have recast the relationship between research and practice. For on this perspective, research is an activity of practitioners. It is triggered by features of the practice situation, undertaken on the spot, and immediately linked to action . . . the exchange between research and practice is immediate, and reflection-in-action is its own implementation. (Schön, 1983, pp. 308–309)

Reflective practice therefore attempts to unite research and practice, thought and action into a framework for inquiry which involves practice, and which acknowledges the particular and special knowledge of the practitioner. It is a framework that encourages reflection in different ways. Retrospective reflection – 'reflection-on-action' – is a critical research skill and part of the generic research processes of review, evaluation and analysis. 'Reflection-in-action' is a particular activity of professional practitioners and involves thinking about what we are doing and reshaping action while we are doing it. In this sense it is improvisational and relies on feeling, response and adjustment. Schön likens it to conversation, especially in relation to design. He suggests that designing is a 'reflective conversation with the materials of a situation' (Schön, 1983, chapter 3, p. 78).

This dynamic process – reflexivity – is an important concept in the development of post-positivistic research methodologies, especially constructivist ones – '. . . we understand and become aware of our research activities as telling ourselves a story about ourselves . . .' (Steier, 1992, p. 3).

Let us return briefly to the idea of 'professionalism'. McKernan (1998, p. 46) suggests that 'the most outstanding feature' of the professional is the 'capacity for self-evaluation and self-improvement through rigorous and systematic research and study of his or her practice' where '. . . the problems of practice are open to reflection and inquiry.' Our book aims to encourage this kind of critical approach through the exploration and application of appropriate research strategies in Art and Design. The 'extended professional', then, is a reflective practitioner-researcher.

The practitioner-researcher

The 'practitioner-researcher' is a particular role, defined as: 'someone who holds down a job in some particular area and at the same time carries out . . . inquiry which is of relevance to the job' (Robson, 1993, chapter 15, p. 446). Robson discusses the advantages and disadvantages of this role (albeit from a social science perspective) most of which ring true for practitioner-researchers in Art and Design. For most of us, problems can arise in terms of time available and other commitments, and possible lack of research experience and confidence. Robson points out a major disadvantage as that of 'insider' problems – the difficulty in adopting an open-minded approach and not allowing preconceptions to cloud the issues. Given that absolute objectivity is impossible, this is a challenge for all researchers – positivists and post-positivists! It can be addressed to some extent by always exposing ideas and practices to other professionals for feedback, support and advice. In seeking the views of others, which will inevitably be subjective, we can develop inter-subjective views, which are less likely to be one-sided. Of course, keeping a critical view of your research at all times is essential.

However, the advantages of the practitioner-researcher role are compelling: your 'insider' knowledge, experience and status usually lends your research credibility and trustworthiness in the eyes of your peers, that is, you are not an 'external' researcher. Most importantly, you are inquiring as a reflective practitioner, acknowledging the complexity, dynamism and unpredictability of the real world.

> One of the essential characteristics of practitioner research is that it is one's own practice that is reflected upon. . . . To look at one's own creative practice means taking on both a creative and a reflective role, in a sense creating a new research model which may use other models but will inevitably have its own distinct identity. (Douglas, 1994, p. 45)

Reflection and action: suggestions

- Consider what characterizes your professional context. How do the best 'professionals' operate in that context?
- In what ways are you already, or could be in future, a reflective practitioner?

- experiencing/exploring, gathering, documenting information and generating data/evidence,
- reflecting on and evaluating information, selecting the most relevant information,
- analysing, interpreting and making sense of information,
- synthesizing and communicating research findings, planning new research.

What methods of practice can be effectively used in this process of inquiry? From the completed formal research to date, the following specific methods can be identified:

- making art/design/creative work through specific project frameworks or as a body of work exploring the research questions, which might include, or be supplemented by, any of the following:
  - observation and related notation/use of symbols,
  - visualization – drawing (in all forms), diagrams,
  - concept mapping, mind mapping,
  - brainstorming/lateral thinking,
  - sketchbook/notebook,
  - photography, video, audio,
  - 3D models/maquettes,
  - experimentation with materials and processes,
  - modelling/simulations,
  - multimedia/hypermedia applications,
  - digital databases, visual and textual glossaries and archives,
  - reflection-in-action/'stream of consciousness'/personal narrative,
  - visual diary/reflective journal/research diary,
  - collaboration/participation/feedback, for example workshops,
  - use of metaphor and analogy,
  - organizational and analytical matrices,
  - decision-making flow charts,
  - story boards, visual narratives,
  - curation,
  - critical writing, publications,
  - exposition and peer feedback/review.

These have been augmented with useful social science methods, usually adapted and/or re-contextualized in some way e.g.:

- interviews, questionnaires, surveys (seeking the opinions of others),
- case study – in-depth study of relevant examples,
- participant-observation – researcher as participant/collaborator in the research,
- personal construct methods – making sense of ourselves in our world(s),
- evaluative techniques, for example semantic differential, multiple sorting,
- soft systems methods.

2 Mapping the terrain: methods of contextualizing research

CHAPTER OVERVIEW

2.1 The purpose and structure of a Contextual Review
2.2 Critical thinking and response: key generic skills
2.3 Locating and using reference materials for Art and Design research
2.4 Undertaking a Contextual Review: mapping the terrain
2.5 A reflective journal
The final topic, whilst relevant to the research process as a whole, is included in this chapter for its relevance to critical reflection and evaluation.

2.1 THE PURPOSE AND STRUCTURE OF A CONTEXTUAL REVIEW

Purpose of a Contextual Review

The Contextual Review is a major part of any research project, its lifespan being as long as the project itself. It is a critical and analytical activity that defines both the scope of the inquiry as well as the state of the relevant knowledge base to date. In this process, it is a 'bridge' between the identification of the research problem – the 'what?' – and researching that problem through the methodology – the 'how?' – and contributes to both. The Contextual Review prompts a number of questions.

- *Why* is your research needed and *what* evidence is there to support this? (Rationale.)
- *Who* else in the field has addressed significant aspects of your research question? (Competitors, contributors, co-operators.)
- *When* (and possibly *where*) was the research carried out? (Currency, cultural context.)
- *How* has the research been carried out, and *what* are the implications of this for your methodology and specific methods?
- *What* aspects remain unexplored or require further work? ('Gaps' in knowledge, new ground.)

The Contextual Review helps to identify precisely the nature of your own research question by gaining more information about its context, both what has already been

addressed, when, where and by whom, as well as what has not yet been addressed. Through the Contextual Review, the hunch that initiated your research project becomes a tangible 'gap' in knowledge.

Structure of a Contextual Review

The Contextual Review is an ongoing activity throughout your research. At the outset, it helps to shape and position your particular research topic and connect it to other significant research, as well as identifying a specific space into which you might make a contribution. This is a mapping process – where is your research in the wider scheme of things? As your work progresses the map might expand, shrink or change shape as relevant new references are identified and reviewed, and some earlier references become less important. In the final phases of the research the Contextual Review becomes an essential section/chapter of your thesis that allows you to explain your argument in relation to selected key references. This is much more concise and directional – like a river, where the main current is your argument into which important tributaries of other research flow.

There are two distinct phases in developing an understanding of your proposed research area through a Contextual Review.

(1) Initial surveys, to establish the proposal's rationale and viability, to provide some background information, and to help focus the proposal. From these searches a set of relevant references/sources can be compiled into a bibliography and/or a 'store' of non-textual source material.
(2) The use of these references/sources to develop a critical review of your research context, leading to the identification of your own particular research question and the development of a convincing argument.

In both phases it is important to keep precise records of your inquiry so that you, and other researchers, can trace and revisit the material. It is also important to keep updating the information with new references as the field around you develops. The research habits of learning to select, record and use references are as important as the content itself.

Phase 1. Initial surveys

In Chapter 1 we examined the important stages of the research process (Section 1.2). The preliminary stages of 'planning the journey' include taking advantage of the knowledge of explorers who have visited similar areas, so that you can acknowledge their 'trailblazing' and not waste your valuable energy going over old ground or travelling towards a dead end. In the case of a PhD study, it is critical to establish that your proposed research topic has not yet been investigated (usually by accessing various databases and websites, for example Index to Theses and abstracts on university websites).

Initial surveys enable you to:

- establish the proposal's rationale – that the research is really needed, that is has professional relevance, and that it should be viable to undertake;
- gain some background information around the proposed topic, define key terms, and elicit some external feedback, perhaps through contact with other researchers/advisors;
- focus the proposal, or in some cases refocus;
- gain information on validated research methodologies used in other completed research.

From these searches a set of relevant references can be compiled into a bibliography/'store'.

It is important that the scope of the inquiry is feasible, and therefore a balance has to be maintained between breadth and depth. Initially it is important to cast the net of contextual enquiry very wide and develop an overview and understanding of the field. This is the mapping stage and can help in deciding what comes within the scope of the research and, equally important, what lies outside.

Once this overview is in place, a few key references/sources will probably identify themselves as being of most relevance to your argument. The selection is made as a result of an emerging awareness of the exact nature of your own research question. (Further details on locating, selecting, reading, managing information, citing and tracing materials can be found later in this chapter, in Section 2.3.)

Phase 2. Critical review

Phase 2 involves the placement of these references/sources into a critical review of the research context to enable the identification of your own particular research question and the development of an argument. In evaluating the 'terrain' you will encounter a range of perspectives. The review allows you to acknowledge these different contributions, but also encourages you to state your responses to them – both positive and negative! Adopting a critical stance is essential and requires an open mind. You must be prepared to have your ideas challenged, and be receptive to different arguments. (For more details on this see Section 2.2.)

Hart (1998) suggests a set of quality criteria for evaluating a body of contextual information:

> Many reviews, in fact, are only thinly disguised annotated bibliographies. Quality means appropriate breadth and depth, rigour and consistency, clarity and brevity, and effective analysis and synthesis: in other words, the use of the ideas in the literature to justify the particular approach to the topic, the selection of methods, and demonstration that this research contributes something new.
>
> (*Doing a Literature Review*, Chapter 1, The literature review in research, pp. 1–2)

So these essential quality criteria – 'breadth and depth, rigour and consistency, clarity

and brevity, and effective analysis and synthesis' – can help not only to evaluate what you have found in the context, but also to apply it in writing/visualizing your own review. (More details on this can be found in Section 2.4.)

At the end of this process you should be well placed to 'locate your position' within the professional context and formulate a viable research question and research strategy (this is covered in detail in Chapter 3).

Reflection and action: suggestions

- Familiarize yourself with the generic process of review by reading Chapter 1, in Chris Hart's useful book *'Doing a Literature Review'* (Hart, 1998, pp. 1–20).
- Think about the kind of 'contexts' relevant to your research ideas.

2.2 CRITICAL THINKING AND RESPONSE: KEY GENERIC SKILLS

Critical thinking and critical response are key postgraduate skills applicable across the whole research process – identifying issues, evaluating context, developing methodology, analysing and interpreting research outcomes, synthesizing and communicating research process and products. These skills will be revisited in all subsequent chapters as part of developing generic professional skills. In relation to this chapter, they are particularly important in enabling critical exploration, considerations, and responses to existing public domain information in your research context in order to make a suitably critical review of it. Understanding and applying these skills will enable you to develop a critical approach to your working context, and to develop an argument – a sustainable research proposition – which is a crucial part of any research proposal (raising a research question will be covered in Chapter 3).

What is critical thinking?

Critical thinking means thinking effectively and applying sound intellectual standards to your thinking. It involves 'meta-thinking' – thinking about your thinking – and self-evaluation. It involves not jumping to conclusions too quickly and maintaining an open mind, considering all aspects of an issue before making up your mind. It involves maintaining some degree of distance in order to prevent personal bias or prejudice interfering with your reasoning. However, this does not mean that a personal position cannot be adopted – indeed, this is the basis of developing a strong argument in relation to your research proposal. Critical thinking is creative thinking – it encourages questioning ('why's that . . . '), imagining ('what if, how about . . . '), connecting ('try linking this to that . . . '), interpreting ('could this mean . . . '), applying ('I'll try this out').

Critical thinking is essential for developing a convincing research proposition – an argument – in relation to what already exists in the research context. An argument is a process of reasoning in which you attempt to:

> . . . influence someone's belief that what you are proposing is the case. . . . Whichever way someone makes an argument they are attempting to convince others of the validity . . . of how they see the world and convince us that we should see it the way they do. (Hart, 1998, chapter 4, pp. 79–80)

Argument

By developing convincing arguments, we can propose different views and contribute to debate in our research context. Stephen Toulmin, writing in 1958, developed a model of a structure of an argument, which has four components.

- *Claim* – an arguable statement, for example formal research in Art and Design is an important activity.
- *Evidence* – data used to support the claim, for example an analysis of the Higher Education Statistics Agency data (www.hesa.ac.uk) reveals a rapid increase in completed research for higher degrees in the creative arts and design between 1994 and 2002.
- *Warrant* – an expectation that provides the link between the evidence and claim, for example formal research in Art and Design should be encouraged.
- *Backing* – context and assumptions used to support the validity of the warrant and evidence, for example formal research should be encouraged because it contributes to the rigorous investigation of practice encouraging new developments and new roles for practitioners.

Being aware of this structure helps us not only to develop our own arguments, but to recognize the arguments of others when listening to debate and reading the published research literature. It helps us to explore the reasoning behind a particular perspective, evaluate its strengths and weaknesses, and evaluate its contribution to our understanding. It is the essence of making a truly critical review of the research context.

Intellectual standards

The critical thinker bases arguments on the use of evidence and sound reasoning. There are intellectual standards[1] (criteria and related questions) that you can apply to check both your own use of critical skills and those of others:

- *Clarity* – Is a statement expressed in the best way? How else could it be expressed? Is it sufficiently elaborated? Is there too much jargon/over-specialized language? Are there relevant examples or illustrations?

  If a statement is unclear then it is difficult to say whether it is accurate or relevant, for example 'higher education is failing students'. This could be interpreted in at least two ways – either that the HE system is not providing an appropriate learning framework for students or that students are actually failing.

- *Accuracy* – Is this true? Can its accuracy be checked? Is it appropriately attributed?
  A statement can be clear but inaccurate, for example 'all research in Art and Design is practice-based'.
- *Precision* – Is there enough detail to explain the meaning? Could it be more specific or more clearly defined?
  A statement can be clear and accurate but not precise, for example 'most methods of distance learning are effective'. We need to know precisely what is meant by 'effective' – for whom and in what context – and the proportion of methods that are effective.
- *Relevance* – How is this related to the topic? Is it truly relevant? Is it out of context?
  A statement can be clear, accurate and precise but be of little relevance to the issue, for example if you were discussing the growth of practice-based research, it would be irrelevant to mention whether the researchers involved were right-handed!
- *Depth* – Are the complexities of the question addressed? Is the statement qualified by reason and evidence? Is it a superficial treatment?
  A statement can be clear, accurate, precise and relevant but superficial, for example collaborative learning is fun!
- *Breadth* – Are there issues that have been omitted? Is there another way to look at this? Are there other acknowledged perspectives on this? Is a balance provided?
  An argument can be clear, accurate, precise, relevant, have depth but still ignore other views, for example a strong argument for the effectiveness of distance learning would lack breadth if it ignored a comparison with other modes of learning or failed to consider the cost involved in buying equipment and spending time on-line.
- *Logic/reason* – Does this really make sense? How does this follow from what was said before? Is it consistent? Does this contradict the previous statement?
  In developing an argument, a range of ideas can be combined. However, if these ideas do not support each other, or are not sequenced properly, or present contradictions, then the combination is not logical/reasonable.

Critical thinking in visual practices

Unlike many other disciplines, where formal logic and serial thinking are predominant, artists and designers are usually visual, lateral thinkers. In our domain we know that there are no certainties, no 'right' answers, no simple solutions, no absolute objectivity. All views are admissible, many interpretations are possible, different 'ways of seeing' are encouraged – indeed, one might say that the ambiguity of visual language is its strength and fascination, and one reason for the persistence of visual practices. In Art and Design education we are encouraged to be critically aware (the 'crit' as a learning method is pervasive) but often we are not adequately equipped with critical skills. Often the vocabulary of critical language is not made explicit, yet we know a good painting when we see one! It could be argued that precisely because of this implicitness, complexity and uncertainty, we need to develop very strong critical skills. Fortunately, most – if not all – of the criteria we have just examined can be applied to the development of our own arguments and the evaluation of others.

Applying critical skills

Being aware of the structure of argument and the criteria of clarity, accuracy, precision, relevance, depth, breadth and reason, you can begin to evaluate the significance and value of relevant materials that might form part of your professional context. In examining the materials it is essential that you maintain an open mind – it's not a question of whether you like it or not! If you are seriously engaging in the research process you must be prepared to have your own beliefs challenged, expect the unexpected, and see 'failures' as valuable information. As we saw in Chapter 1 questioning our assumptions about research is an important part of becoming an effective researcher.

One useful critical method is to 'play devil's advocate'. This involves deliberately taking a conflicting or different (possibly uncomfortable!) position in order to see things from another perspective. It can make us aware of the limits of our own knowledge and understanding. Try to outline the strengths and weaknesses of different positions in order to explain/justify/defend your preferred position. Flexibility of thinking is a creative characteristic. Playing with ideas, adopting an 'imaginative agenda', extends our capacity for creative response and may even prompt a shift in position and an advancement of understanding.

Another useful device for making sense of, and understanding, ideas is to develop a conceptual framework. For example, if we were trying to evaluate and make sense of 'research' we could develop a framework for understanding it by using a *concept map*. The map might contain concepts such as:

- purpose of research,
- types of research,
- kinds of research questions,
- methodological assumptions,
- related literature/public output,
- scale and scope of research, and so on.

(See Hart, 1998, Figure 6.10, p. 157.)

This kind of conceptual framework allows us to develop an overview of the topic/idea and to begin to ask questions of it. The overview (or generic) framework could then be used to develop a more subject specific framework. Of course the idea of gaining an understanding of something by visually mapping it is a key method for artists and designers, and something that is considered in more detail in Sections 2.3 and 2.4.

By applying critical criteria and methods you can develop a sound understanding of your professional context, the significance and value of key arguments within it, and adopt a considered personal position, argue for it and defend it.

Critical writing

In relation to the Contextual Review, different styles of writing may need to be adopted at different stages. In the survey and mapping stages it is important to gather and record factual information; for example:

of this information, the proposal may need to be modified or refocused to ensure that you are not 'reinventing the wheel', and that you have the opportunity to make an appropriate contribution to the research area.

Locate and select – the importance of keywords

Only broad guidelines can be given on searching, because the materials found will be specific to your research context, and even more specific to your particular research proposal. The *Visualizing Research* website (💻) includes a set of useful resources and links to related sites – a good starting point for searching. However, your bibliography will necessarily be subject-specific to a great degree, and will draw on your particular professional context. It is easy to get carried away – so much information is now accessible that it is necessary to keep a reasonable focus through the use of keywords. Use a maximum of six. Your keywords are crucial in starting the search for relevant materials so it is worth reflecting on their relevance and accuracy. They provide criteria and parameters for searching, and may need to be expanded, contracted or amended depending on the results of initial searches. Orna and Stevens (1995) suggest an interesting metaphor – 'fishing' for information: where the keywords are 'hooks' (see Oma and Stevens, 1995, Chapter 3, p. 41).

In searching for information, be prepared to be simultaneously depressed and excited – depressed because you cannot find anything to match your needs exactly, and excited because this means that your line of inquiry could be unusual or even unique. Be prepared to step out of both your subject area, for example painting, and even your discipline, for example design, into related (or hitherto unrelated) disciplines (for example education, geology, history, astrophysics!). This could be likened to searching for intelligent life in the solar system and further out in the universe (see Figure 2.1).

Do not simply rely on one or two sources of information (for example Art Abstracts, ARIAD) – different resources cover different types of information. The likelihood is that you will need to combine information from many different (and possibly unlikely) sources to gain a reasonable picture of what already exists and is relevant to your proposal. In addition, do not rely on a single search – you might need to reiterate the process using new keywords or a more constrained set. Venture out into the information universe as often as possible!

Identifying a 'gap' in knowledge and providing evidence for it

Especially at doctoral levels, it is crucial to ascertain what other PhD research exists in relation to your proposed research area. Your claim of making an original contribution to knowledge will partly rest on demonstrating that there is no similar research. In reporting the results of literature surveys and other contextual searches, many research reports and PhD theses often state that there is a 'lack of research' without providing sufficient evidence to justify that statement. A useful structure to address this could be as follows.

Reading – but not as we know it!

Most of us enjoy reading a gripping novel, and usually we resist the temptation of peeking at the final chapter! However, reading at leisure for relaxation and pleasure is very different from reading for a Contextual Review, rewarding though the outcome might be. You will probably identify many sources of information that you need to assimilate quickly and form an opinion on. Fortunately there are several sources of advice that provide very useful suggestions and guidelines for this kind of focused reading (for example, Hart, 1998, Chapter 3, pp. 53–56). A suitable methodology might be as follows:

- obtain the reference/source material and don't forget to capture publication/public output details in your bibliography (to store information efficiently you may wish to use commercially available software applications such as ProCite or EndNote to keep a bibliography database);
- try to get a quick overview of content and structure – look at the index/chapter/section headings;
- keep your keywords/research descriptors in mind – they are like 'spectacles and sieves' to help you focus and select;
- scan and 'skim' read (try scanning down the middle section of the page) – the theory is that your peripheral vision picks up the rest;
- scan/'skim' read the introduction/abstract and the summary/conclusions;
- read more carefully the various sections that seem significant;
- if you photocopy sections, use coloured highlighters on the copy to code key content, for example key words could have different colours to help identify different types of relevant information;
- extract key information – Buzan (1999, Chapter 24, pp. 235–238) proposes an excellent technique for mind mapping a book, or you could interrogate each set of information with a consistent series of questions – what? why? who? where? how? when? (this makes comparison between sources easier);
- while you are reading/mapping, take note of the quality of the information – you could check it against critical quality criteria such as: clarity, accuracy, precision, brevity, breadth, depth, relevance, rigour, consistency, reason, effective analysis and synthesis.

It is likely that you will want to revisit certain references and read them very thoroughly to confirm your initial understanding and extend it. It is also likely you will want to update/expand your bibliography accordingly. These strategies could be adapted for reviewing other materials in other media. By adopting some of the suggestions for reading, the information universe will not seem as daunting!

Managing information

The information you derive from these searches must be carefully captured and stored (see Figure 2.2). Hart (1998) provides an interesting diagrammatic overview of the

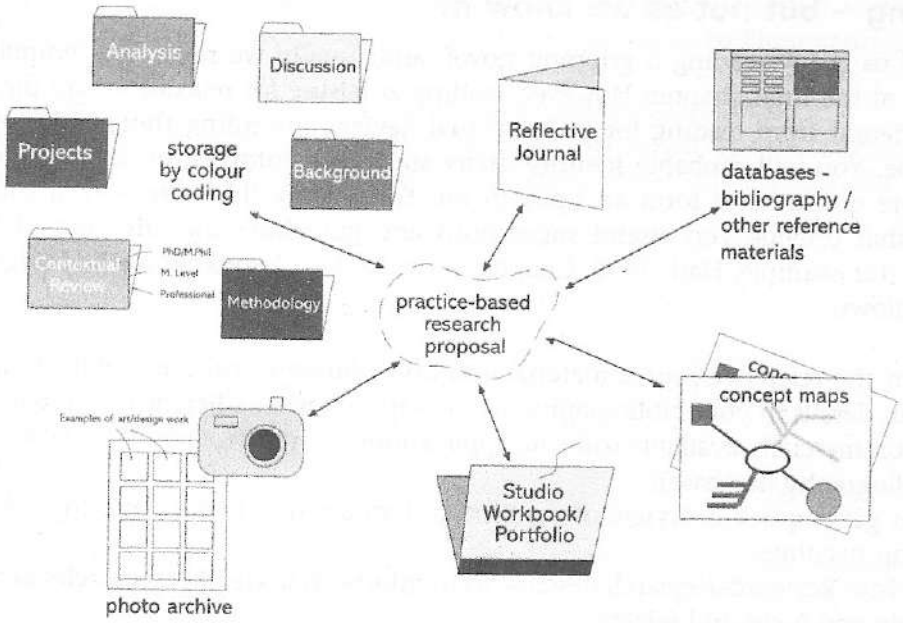

Figure 2.2 Possible methods of managing information for the Contextual Review (💻)

different kinds of devices useful in managing information, for example a 'search diary', 'memory cards', 'action plans', mind maps, quotes, correspondence and contacts, and so on (Hart, 1988, Appendix 4, pp. 215–218). Some of these techniques are described in detail and should prove helpful. In addition, Orna and Stevens (1995, Chapter 3) provide excellent advice on a range of methods for managing research information.

You may like to consider setting up your own coding system, for example using coloured highlighters for different kinds of information when reading texts – your colour coding system could extend to files, folders on your computer or even specific colours for computer disks for storing back-up files. You might consider developing other kinds of databases, for example for research contacts/correspondence, project images, and using an organizational structure such as a matrix to store information.

The importance of accurately capturing and properly managing information cannot be stressed enough. This is an essential part of the rigour of research. A convincing argument cannot be made unless your claim is backed up by evidence. Careless handling of initial data can compromise the quality of your evidence. (These issues will be expanded upon in Chapters 3, 4 and 5.)

Using bibliographic software

There are a number of commercial software applications available that will assist in compiling a database of references, for example ProCite and EndNote. The more recent versions of these applications will handle graphic information as well as text.

By 'playing' with the references – organizing them in different ways – you could end up with several maps to help you decide how to structure your review. In order to 'see' what you have got and 'where to go with it', using different kinds of mapping techniques can be helpful in understanding the 'terrain'. Three examples of mapping techniques are now described.

Mind map

A mind map (Buzan, 1998) is a useful way of sorting out these references. In this process, your keywords should help to prioritize and locate the references: is there anything that relates directly to *all* your keywords? If so, then this (or these) is the centre of your map. Is there anything that relates to *most* of your keywords? Again this/these can be positioned relative to the main reference(s) on your map. The basis of this map could be a 'target-like' structure with concentric rings to help locate and differentiate between degrees of importance. Carry on with this process until you have located and related all your references. Some might be so far towards the edge of the map that they can be removed. You may need to go through this process several times to feel happy with your selection. There are a number of software applications available for developing mind maps, for example Inspiration (http://www.inspiration.com/). See Figure 2.5 for an example of mapping.

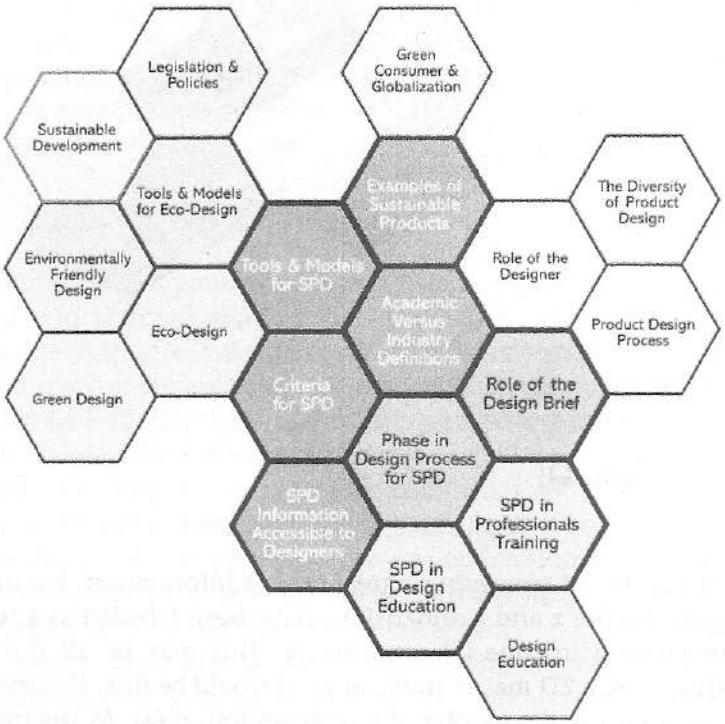

Figure 2.5 A hexagon map of sustainable design issues (💻) (example from a PhD in progress)

- use of visual overviews and more specific visual materials – include illustrations of work discussed whenever possible;
- summaries/reviews to close each section (remind the reader briefly what you have said).

Your Contextual Review will never be definitive, and will probably need to be reviewed and updated during the course of your research. In this sense, it is provisional and should be 'modelled' as your research progresses and your context develops.

Reflection and action: suggestions

- Find three examples of Contextual Reviews in your research area – what are their particular characteristics, that is structure, content, style, and so on?
- How do these three reviews stand up to being evaluated using Hart's quality criteria? (You could use a matrix structure to do this evaluation.)
- Choose 12 key references from your bibliography/'store'. Map them in relation to each other, then visualize the flow of your argument. Use this to write a draft Contextual Review.

2.5 A REFLECTIVE JOURNAL

Experiential learning and 'off-loading'

In Chapter 1 we considered the important concept of 'reflective practice', and various modes of reflection. In addition to Schön's reflection 'in' and 'on', John Cowan proposes the concept of reflection 'for' future action (Cowan, 1998) see Figure 2.8.

This addition suggests a dynamic and recursive reflection process, which relates to David Kolb's experiential learning cycle (Kolb, 1984). Briefly, Kolb proposes four stages of learning from experience: do, reflect, summarize, test. McAleese (1999) has built on

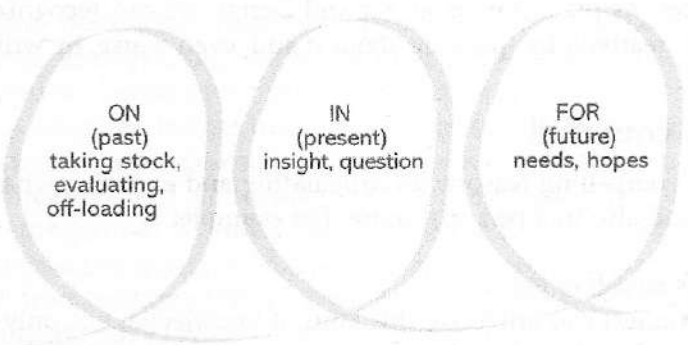

Figure 2.8 Reflection-for-action – a looping process (adapted from Cowan)

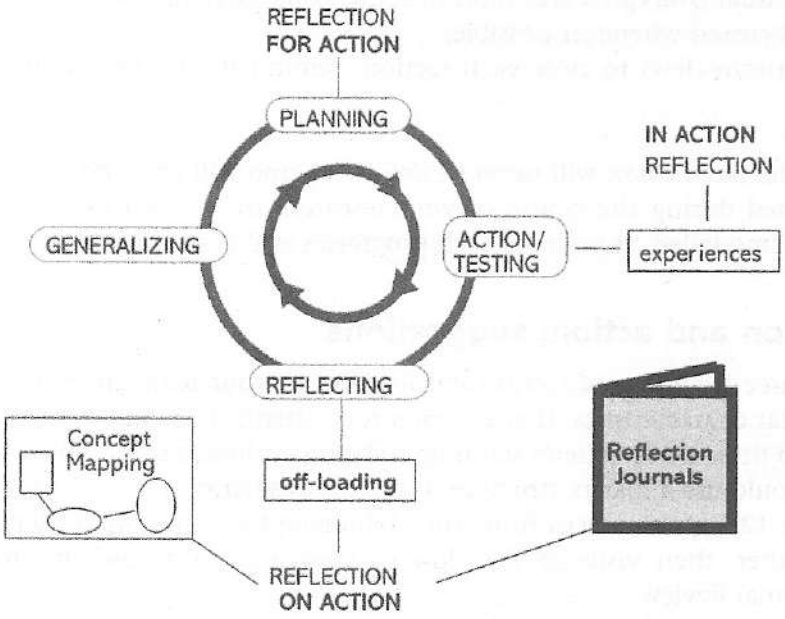

Figure 2.9 Reflective journaling as part of the 'Serious_Fun Framework' (💻) (adapted from McAleese)

this model in his research on skill acquisition, and proposes two main tools to enable and externalize reflection-on-action: concept mapping, and reflection journals. These tools are described as 'off-loading' devices – presumably because they allow the learner to take stock, evaluate and 'deposit' ideas and feelings about the learning experience. This kind of 'off-loading' enables the learner to continue the cycle 'unburdened' as it were and to be ready for new learning experiences.

The idea of 'off-loading' into a reflective journal for instance goes some way to address Schön's concern about the difficulty of articulating the 'knowing-in-action' of professional practices. As practitioners in Art and Design we can recognize the fear of losing or damaging creativity by speaking about it and, even worse, by writing about it!

Reasons to be cheerful!

However, there are compelling reasons for articulating and exposing what we do, in a professional sense and also in a personal sense. For example:

- *Developing various models of practice*
  If we as practitioners can articulate this kind of knowledge, not only are we more likely to develop clearer epistemologies of practice, but also to understand better the diversity of that practice, as well as the core characteristics. This provides extremely valuable information for practice-based research, which usually requires a descrip-

kind of information will need to have factual and precisely detailed records, so that you (or someone else) can recreate the effects. Fact, precision and detail are the characteristics of activity logs. These records may include visuals, photographs, material samples, diagrams, charts, numerical data, video/audio and, of course, text. One of the most amazing kinds of 'life log' is the architect and polymath Buckminster Fuller's 'chronofile' (Krause and Lichtenstein, 1999). As a very young man he took the radical decision to regard his life as an experiment, the failures and successes of which he would document as extensively as possible. The result was a comprehensive collection of data – letters, postcards, photos, sketches, even receipts – 'a life's transcript' (Krause and Lichtenstein, 1999, p. 14) spanning almost 75 years!

Other events and experiences may be recorded in a less comprehensive way, perhaps using more descriptive and discursive means – as in a diary. Brian Eno provides us with an interesting example of a diary in his *A Year With Swollen Appendices* (Eno, 1996). David Hockney's contribution to Stephen Spender's (1993) *China Diary* is a different kind of travel journal, with the emphasis very much on the visual. An excellent example of yet another kind of 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, 1997, pp. 92–95.) Again other media may prove useful – the idea of a 'video diary' for some people can be attractive, to others completely intimidating! For some a 'visual diary' might take the form of a multimedia document or even a website.

The documentation of work in progress is essential for both practice and for research. For the purposes of the journal, colour photos/digital images ('snaps') are useful and relatively cheap. Of course, good quality 35 mm transparencies are standard requirements for documenting professional outputs (especially three-dimensional work), but equally important in the context of a reflective journal are all the stages of the work's development – warts and all! 'Failures' are extremely helpful in research terms. Asking why a failure has occurred is liable to reveal much more useful information in research terms than contemplating 'successful' final outcomes. This concept provides a very important insight into the difference between 'practice per se' and research. Naturally, the focus of attention, when it comes to practice, is on the final result. In research, however, the focus of attention is much more likely to be on the process and to providing an explanation as to why things have not worked, hence the importance of making the process transparent and being rigorous in the recording of procedures.

Most reflective journals would contain contextual references. Many practitioners amass a great collection of visual examples of other practitioners' work, and some selected examples could be included in the journal. However, it is not enough to simply paste in a postcard or magazine cutting – do not forget to provide details about the work and, most important, what you think of it and why it is significant (similar to the type of information you would include in a bibliographic database).

As the journal relates to your research journey, it is helpful to include information about the pace and progress of your work. A Masters student developed an interesting visual example of this kind of information. The visual very clearly and honestly describes the 'peaks and troughs' of the project's development in relation to the time scale of the course (Figure 2.10).

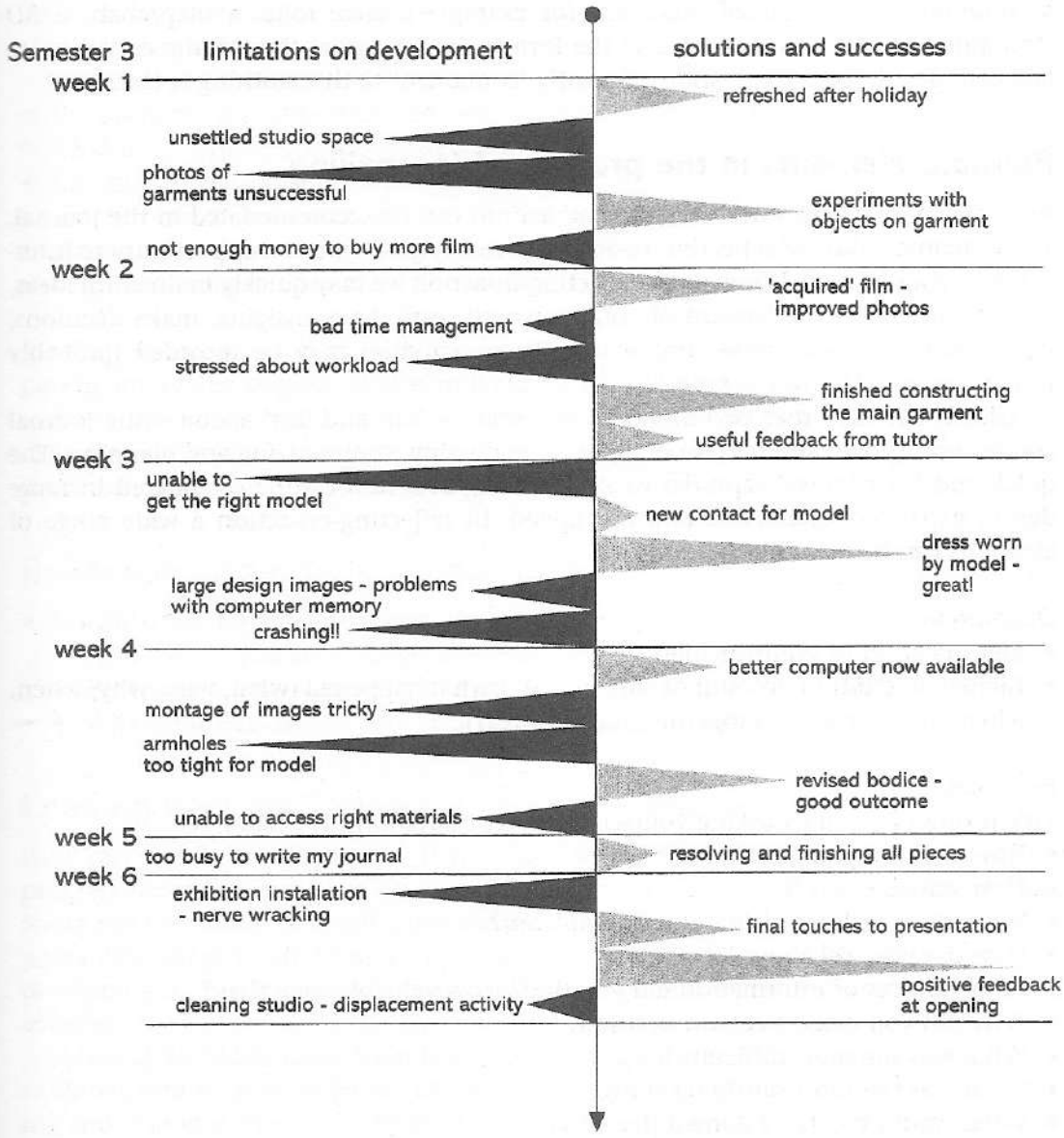

Figure 2.10 Example of visualizing the pace and progress of a project

The 'mountains and valleys' encountered in the journey also help to identify key summary points for evaluation and analysis – key incidents, events, decisions, realizations, and other kinds of relevant 'life' information. The description and 'unpacking' of this kind of visual helps to develop analytical and evaluative thinking, which Cowan (1998) suggests is the key function of a reflective journal.

We have suggested that the journal may not necessarily take the form of a book. You may want to consider a range of possible formats, which might more easily

accommodate visual/actual materials, for example a large folio, a map/chart, a 3D 'container' of some kind. Whatever the format, it is essential that all the contents are labelled, dated, sequenced, and sufficiently 'contained' so that nothing is lost.

Possible elements in the process of journalling

All types of reflection ('in', 'on' and 'for' action) can be accommodated in the journal. The dynamic nature of reflection-in-action probably gives you less opportunity to interact with your journal, however, in reflecting-in-action we may quickly brainstorm ideas, talk to ourselves (in a 'stream of consciousness' way), have insights, make decisions, make changes, re-orientate, and so on. These activities may be recorded (probably briefly and quickly) in the journal.

Clearly, in the other two modes of reflection – 'on' and 'for' action – the journal comes into its own as a tool for describing, evaluating, summarizing and planning. The quick and brief 'notes' captured while reflecting-in-action can be considered in more depth, expanded, elaborated and completed. In reflecting-on-action a wide range of elements can be included.

Description

- Identification of event/incident.
- Factual description/account of what you did/what happened (what, who, why, when, where, how – methodology/methods, context).

Evaluation

This is often helped by asking yourself a series of questions, for example:

- How well did you do it?
- How valuable was it?
- What did you learn? What didn't you learn?
- How did you feel about it?
- What sources of information did you find? How valuable were they?
- Why did you make a certain decision?
- What was the most difficult thing?
- What was the most satisfying thing?
- What would you have done differently?

Summary

- List pros and cons/strengths and weaknesses.
- What does it all mean?
- What advice would you give someone?
- Identification of new key questions.

In reflecting-for-action, you should use the information gained in the previous reflection mode. In contrast to the previous mode, reflecting-for-action is much more about refinement, narrowing and focus. This mode relates to both your learning strategies for

research and obviously your research proposal. A range of elements can be included in this planning mode, for example:

- the declaration of intentions and expectations;
- what if . . . ? (projection, speculation);
- the pros and cons of projections;
- the proposal of solutions or a way to obtain solutions to questions;
- the identification of scope for improvement and how to achieve it;
- the identification of most significant next step and why.

A reflective journal is essentially a personal document, and is not usually assessed (as part of any higher degree). However, it can provide you with a whole range of evidence and examples that could be useful for the development of your research project, for discussion with your supervisors and other students/peers, and for discussions with and presentations to potential collaborators.

Reflection and action: suggestions

- Consider the idea of a reflective journal. Ask yourself:
  - Why should *you* keep a reflective journal?
  - How would *you* go about it and why?
  - What kinds of content and structure might *your* journal have and why?

Looking back on Chapter 2: mapping the terrain

How can you know what's new if you don't know what already exists? How can you progress on your journey of discovery unless you are aware of the surrounding landscape and the nature of specific features of the terrain? How can you avoid dead ends or going over old ground? Answer – by making a thorough survey of what is out there and developing a critical understanding of what is directly relevant to your own research context.

Making decisions about what is an important feature of the research landscape to be explored, and what is irrelevant and why, is a key research skill requiring critical thinking and response. We have described ways of helping you evaluate the significance and relevance of existing contextual material, such as applying accepted critical criteria as well as more imaginative questioning strategies.

In attempting to get a sense of what is out there, various pragmatic strategies for searching, scanning, and surveying need to be used. Whatever is discovered needs to be carefully stored, organized, selected and prioritized, contributing to your developing view of the research terrain and identifying the unexplored spaces within it. Part of this careful surveying requires that you know how to retrace your steps – how to find your way back to some significant source and allow others to do the same.

Demonstrating your understanding of the research terrain can be achieved in different forms – there is no one right way. However, you might start off with a mapping

activity making thematic groupings or clusters of similar sources, describing/visualizing the different kinds of relationships between clusters – for example, distances between, similar and contrasting features. Then, using the power and flow of your argument to make sense of your key sources, cut through the landscape like a new river, and convince us that there is indeed a void in knowledge to which your research might contribute.

Some travellers keep a 'journal' as a way of reflecting on, and making sense of the experience of exploration, through plotting key co-ordinates on their map. The reflective journal helps you to see where you've been, know where you are and, most importantly, imagine where you want to be.

REFERENCES AND FURTHER READING FOR CHAPTER 2

References

AXIS – register of practitioners and work, http://www.axisartists.org.uk.

Buzan, T. (1998) *The Mind Map Book: Radiant Thinking – a Major Evolution in Human Thought* (London: BBC Books).

Cowan, J. (1998) *On Becoming an Innovative University Teacher: Reflection in Action* (Maidenhead, Berkshire: SRHE/Open University Press).

Endnote, www.endnote.com.

Eno, B. (1996) *A Year With Swollen Appendices* (London: Faber & Faber).

Hart, C. (1998) *Doing a Literature Review* (London: Sage).

Kolb, D. (1984) *Experiential Learning: Experience as the Source of Learning and Development* (Englewood Cliffs, NJ: Prentice Hall).

Krause, J. and Lichtenstein, C. (eds) (1999) *Your Private Sky: R. Buckminster Fuller. The Art of Design Science* (Baden: Lars Müller).

McAleese, R. (1999) Skill acquisition – the curious case of information searching. *Teaching of Information and Communication Sciences, Euroconference*, September 1999, Pontificia de Salamanca, Spain.

McKernan, J. (1998) *Curriculum Action Research: a Handbook of Methods and Resources for the Reflective Practitioner* (London: Kogan Page).

Miles, M. B. and Huberman, A. M. (1994) *Qualitative Data Analysis*, Chapter 9, Matrix Displays: some rules of thumb (Thousand Oaks, CA: Sage).

New Collins Concise Dictionary of the English Language (1988) Managing editor W. T. McLeod (London and Glasgow: Collins).

Orna, L. and Stevens, G. (1995) *Managing Information for Research*, Chapter 2, Mapping the research territory: known and unknown; and Chapter 3, Managing information to support research (Maidenhead, Berkshire: Open University Press).

Procite, www.procite.com.

Spender, S. (1993) *China Diary* (with illustrations by David Hockney) (London: Thames & Hudson).

Toulmin, S. (1958) *The Uses of Argument* (Cambridge: Cambridge University Press).

Tufte, E. (1997) *Visual Explanations* (Chesire, Connecticut: Graphics Press).