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A visual thesis? techniques for reporting practice-led research

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A Visual Thesis?   Techniques for reporting practice-led research.

This paper describes an approach taken to the use of visual material as a significant part of PhD thesis in an Industrial Design research project. The aspiration to make creative work central to the thesis has been debated in a wide range of disciplines, but there are few examples of successful practice, especially in design. The authors sought to make visual material central to the process of developing a PhD thesis and worked with a research student to put this into practice. The process was beneficial to both the student and his audience and it is hoped that this approach provides a starting point for further development of practice-based research.

Introduction

In Design, as in other areas of scholarship concerned with creative practice, there is a continuing debate about the nature of research and the forms in which research is communicated. The United Kingdom Council for Graduate Education has, for some time, worked on developing understanding of research in "The Creative and Performing Arts and Design" (CPAD). This grouping includes Music, Creative Writing, Performance & Dance, Theatre and Fine Art, as well as Design. The process started with a report into practice-based Doctorates (UKCGE 1997) and is continuing with a study of approaches to research training by a group[1] which includes one of the authors of this paper.

In general these are newer academic disciplines, although Music has been well established within universities (in the UK) for a very long time, while Fine Art and Design are relatively late arrivals, often in newer universities. In all cases there is concern about the forms for communicating research but this appears to be a smaller problem in Music, where the concept of a shared disciplinary language, which is not written in conventional text, is well established. By contrast, within the Design community, there is continuing and sometimes heated debate about the nature of research, including the appropriateness of the conventional thesis form. A visit to the archives of the Design Research Society email discussion list for the first half of 2000[2] will provide a snapshot of this debate.

Within Design, of course, there is a wide range of research for which these issues do not appear to be important, where the methods used are closely related to well-established practice in Natural Sciences, Social Sciences or the Humanities and the traditional forms of writing are effective and appropriate. However we believe that there is potential for creative individuals in Design to make distinctive and significant contributions to research and that there is an opportunity for such people to develop both new methods of enquiry and appropriate forms of communication which may be more direct and accessible than a conventional text.

There are examples from other fields which may illustrate the issues. A colleague in creative writing, has reported a PhD project (Harper 1998) in which the central activity was the writing of a novel. The novel, on its own, did not make clear the nature and outcomes of the enquiry which had taken place and, in other similar cases, research students have provided a conventionally structured and argued thesis to allow the research to be understood and examined. In this example, however, the student chose to provide a series of fictional documents (spoof interviews, correspondence and diary entries) representing a debate about the novel, which fulfilled the same purpose but allowed him to use the form of communication in which he had the greatest competence, and one with which his audience was also very familiar. In this case, because the "thesis" was a written text, the departure from normal forms may not have been apparent to the university authorities but in practice it was a radical shift.

Within Design, Lars-Henrik Stahl (2000) has described a process in which PhD students in Architecture frequently start with high ambitions to "Make a dissertation instead of writing one". This early idealism is eroded as the research proceeds and text begins to dominate to the point where the artefacts are reduced to illustrations of arguments and discussions in the text. Stahl links this shift of emphasis to an increasing concern, as the student progresses, with "theoretical implications on a meta level" and it is reasonable to suppose that students' increasing awareness of theoretical issues and the widest context of the research can undermine a wish to allow artefacts, which are often local and specific, to speak for the research.

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[1] UKCGE Working Party on Research Training in the Creative and Performing Arts and Design, 2000-2001
[2] May be found at http://www.jiscmail.ac.uk/lists/drs.html

A new research student who hopes to "make" their thesis is seeking to make a huge jump into the unknown. Without a practical, reasoned approach, starting from an understanding of what can be achieved, it is not surprising that students abandon their aspirations once reality intrudes. It may be more practical to consider a progressive approach in which relatively limited but achievable goals might lead to something that would be useful in itself and a step forward in understanding the role that artefacts might play in future "made" theses.

Rivka Oxman (1997) has suggested that "a sequence of sketches can act as record of reasoning processes which can be inferred from transition states from one representation to a subsequent representation". In the project described below, drawing was used extensively to gain understanding of anatomical and mechanical problems and to visualise and develop design concepts. In fact the term "creative reasoning" was coined by the research group when seeking to explain, to an audience of scientists, the use of iterative cycles of drawing and/or making and evaluation at the heart of the investigation. This view of artefacts representing reasoning processes may be self-evident to many practitioners but it is worth establishing as a working principle for researchers, which may help them to prepare the ground early in their work for a thesis which gives a significant role to artefacts.

A Visual Thesis in Design?

Recently, we had the opportunity to consider these issues in a practical context in the supervision of a PhD project carried out by the Industrial Designer, Graham Whiteley. This project, aspects of which have been described previously (Rust 1998, 2000), was conducted largely through an investigative, experimental use of practical design activities. The aim was to identify new mechanical principles for prosthetic and robotic arms.

The researcher had previously published refereed papers on his work for Medical Physics audiences (eg Whiteley 1999) and it would have been possible to produce a conventional Medical Physics thesis. However there were a number of reasons why this approach would have been unsatisfactory.

Firstly the examiners for the PhD were drawn from both Medical Physics and Design and it was important to ensure that the work was comprehensible from both perspectives. It was also intended that the thesis should be accessible to a wide audience, including prosthesis users and professionals in manufacturing and prosthetics services, since one aim of the research was to stimulate practical developments in this field. It was felt that this multi-faceted requirement could be supported by the use of visual material which might be understood from several viewpoints in parallel, whereas a text alone may be danger of speaking to a single audience.

The research had resulted in a great number of drawings and 3-dimensional objects, which together represented and made explicit the processes which had been followed. It was clear that the quality and nature of this material was important evidence of the research and would help to validate the outcomes. From consideration of other research in prosthetics and robotics (Caldwell 1995, Hannaford 1995) it was evident that the quality of experimental devices had a bearing on the success of the research and written descriptions did not always express the subtleties and complexities involved - one of the continuing problems in reporting the work has been the different values and meanings placed on activities and language by the different academic and professional communities involved.

To take a simple example: the term "model" is widely used by designers to refer to physical, as well as conceptual artefacts. However, when the word is used in the medical physics community,

it is generally taken to refer to a mathematical model. This conceptual division may seem trivial but it pervades the thought of both communities and requires a writer to be constantly vigilant in providing qualification of terminology whereas, with a good quality image of a model, it is immediately clear what is meant.

A further consideration was that, although the researcher had engaged with a great deal of knowledge and thinking in the medical physics field, he was not intending to put his work forward as medical physics research, directly comparable with other work in that field, and needed to signal the interdisciplinary nature of his work to the examiners. Finally, he had a great deal of ability and experience in graphical communication and was able to develop ideas and communicate with much greater effect through visual media than through text.

Taking account of this we believed that visual media should play a significant role in the thesis but we had no real scheme for making this work. Much of the debate about forms of thesis in Art and Design starts with the assumption that a "body of creative work" would be best examined through an exhibition and this approach, which is explicitly provided for in some university regulations, is widely used in Fine Art, usually through a combination of exhibition and text. These two elements may be complementary or the text may be used to provide a commentary on the work. Neither approach is satisfactory - the first can lead to confusion about the relationship of theory and practice, we have heard research students state that "my work is 50% theory and 50% practice", and both approaches raise the problem of providing a permanent record of the research, sufficient for others to understand fully what happened.

This lack of suitable models was a significant problem for the research supervisors since, in most fields, a PhD student is not expected to invent the form of their thesis and is able to refer to many examples of previous theses in their field. Our student had very few relevant examples, and none which seemed to be appropriate for his situation.

Development Process

Confronted with this problem, our response was to bring all the 3D and 2D material from the research together, spread out on a very large (2.4m x 1.2m) table and with suitable refreshment available. We (supervisors and student) spent an evening discussing specific objects and drawings, reminding ourselves of their role in the research and the connections between them, attaching post-it notes with comments and reminders. A researcher in another tradition might have had a great weight of notes recording their work and have written several chapters of their thesis at this point. However it became very clear that the visual "archive" which we had was far more useful to us as a record of the research since all the events, decisions and connections of the past three years were laid out in view and instantly, concurrently accessible.

Of course this was dependent on our memory of the actual events and would be meaningless to a person who had not taken part in the research, but it was a good illustration of the power and richness of physical artefacts as a record. This was also very relevant to the fact that, in contrast to earlier, reductionist work in this field, it had been considered important to take a holistic approach, and we believed that the ability to consider many issues in parallel is greatly aided by the use of rich objects and drawings.

At this point we still had a working assumption that there would be an exhibition and that provided a starting point for the process of compiling the "thesis". The approach agreed was to construct a series of composite images, comparable to sections of an exhibition. Each of these would bring together the objects and drawings relevant to a specific issue or event in the research. From there, we hoped to move forward by adding text as appropriate.

The first outcomes were encouraging. A series of composite images was compiled, describing the development and evaluation of principles for an analogous finger joint. As well as bringing in drawings and photographs from the research, some new illustrations were produced to illustrate anatomical or technical issues and also to provide some "wayfinding" for readers who were not familiar with anatomy. From this it was possible to identify, for each image, a list of "bullet points" which required clarification in text and to move on to the written descriptions.

For the student, this was a very productive and helpful process. It was natural to work from his images and models (his visual notebook) and he developed the narrative and structure of the thesis far more quickly and fluently than his earlier experience of starting with a text.

Some principles were adopted for the page format of the thesis, the most important being that the figure title for each image should also provide a heading for the supporting text which must be on the same page. Where the text required more than one page it was necessary to repeat the image on the second page or consider whether to reconstruct the image to provide two new composite images. A system of referencing individual images back to the archive was devised, using a drawing number and grid overlay, and further wayfinding help was provided by using small anatomical diagrams at the top of each page. It was not possible to use double line spacing while keeping text and images together so the University Research Degrees Committee approved the use of single spacing. Fig 1[3] shows a sample page from the thesis.

As the thesis developed it became apparent that an exhibition would not be helpful to the examination or add much to the picture presented. An exhibition might provide a compact overview of the work but it would not convey its real substance. While practice in many areas of art and design leads quite naturally into exhibition, which is often the principal output, it is arguable that industrial design is primarily concerned with providing outputs for "clients" who are interested in producing or using artefacts. In this research, the "clients" are those who may employ the knowledge arising in further research or for practical application, for this group the thesis is an appropriate outcome.

The project has also led to the production of a small batch of "test-rig" models of analogous skeletal arms which are being supplied to other research centres who wish to use them for investigations into artificial muscle and control problems. Again, this seems to be a more useful and appropriate output than a public exhibition. Although there are plans to exhibit the work at suitable venues in future, these are seen as opportunities to generate interest in the work, rather than to inform people at a deeper level.

There remained the problem of a full permanent record of the practical work and steps were taken to ensure that the drawings and models (several large boxes full) could be archived by the University Library. However, it was eventually clear that this would not be necessary for comprehension of the context, scope, methods or outcomes of the research since the images in the thesis recorded most of the significant material in sufficient detail. The archive will be kept, as planned, in the hope that it will be helpful to scholars who wish to conduct their own research into designing and researching in this field. For most practical purposes, however, the printed thesis should provide a sufficient record.

The thesis follows a conventional chapter structure, following the layout principles described above for the descriptive sections dealing with context and research activity, but using a more

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[3] Fig 1 is not included here for technical reasons, however a copy of the thesis in pdf format can be found on the Sheffield Hallam University Art and Design Research Centre Website via www.shu.ac.uk/design

conventional format to discuss methods and conclusions. The final document does not, on first inspection, appear unusual and a new reader will approach it as they would any other text. However, from the experience of the research group, it appears that, once a reader has gained an overview of the work, they will use the images as their main aid to navigating the thesis and refreshing their memory, the text being consulted when specific details must be checked.

The text was written in short sections relating to the composite images, but care was taken to ensure that the text narrative flows through each chapter and, probably, this has been helped by the method of starting with a series of images which establish the structure of the narrative.

Technical Issues

The choice of software used to compile the thesis was unusual. Despite having access to a range of sophisticated software tools for graphics and document production, we chose to use Microsoft PowerPoint, which is widely used for compiling slide shows, but is not thought of as a method of producing large complex documents. There were two reasons for this.

Firstly, PowerPoint is almost universal software, being available on the majority of personal computers used in education and business. This meant that there were no barriers to distributing copies of the developing thesis to supervisors and colleagues who could provide advice or help with proofreading. In the longer term it would not be difficult to distribute all or part of the thesis in data form, or to convert it to Acrobat or html format for the world wide web. This is very important since the wide use of computers and the internet has made the distribution of large documents much easier and less costly but we have seen several examples of attempts to do this which fail because they use software (chosen for its technical features) which is not compatible with the majority of computers available to the audience.

Secondly, PowerPoint lacks some of the sophisticated tools available in other graphics programs, and will not produce images of the highest quality, especially when printed at large scale. However these apparent drawbacks result from very significant advantages. The basic graphical editing tools provided meet every need encountered in this project, they were very easy to learn and use and gave quick results. Arguably, a more complex program would have been more difficult to master and slower in use. Similarly, PowerPoint stores images in a very compact form, which may compromise quality but allows a great number of images to be included in a document without an excessive burden on either data storage or speed of use.

Conclusions

This project is a long way from the "Holy Grail" of a thesis constructed entirely of creative work (Biggs 2001), and we do not wish to suggest that such a thing will ever arise in Design. Nevertheless, from a Designer's perspective, we see no harm in this idealistic vision and it has helped us to recognise what can be achieved and seek an appropriate form.

From a pragmatic attempt to construct a thesis that reflected the nature of the research, we believe that we have evolved a useful form for recording and organizing design research. The form developed has since been adopted by design students and researchers at several levels in the university. From discussions with design researchers in other disciplines, it seems to answer a number of problems facing researchers, especially PhD students, confronted with the need to record and report their work in a thorough and rigorous way.

A specific outcome has been the recognition that the wide assumption that a "body of work" is likely to require an exhibition may not be true for many researchers in design, and it is important

for designers to recognise their audience and the purposes of disseminating their research. Our approach has also unlocked the problem of ensuring that a full record exists after the examination - arguably this is a fuller record than many Science PhDs which do not provide unequivocal evidence of any practical work which was carried out.

The process is greatly helped by computer resources such as digital cameras and scanners, which have only recently become ubiquitous, and the decision to use PowerPoint software was a lucky break . Perhaps the main factor in producing this thesis in this way was that the resources were there to do it.

The principal benefit has been In the accessibility and communicability of the research. The thesis has been read and found useful by people with widely differing backgrounds and purposes, it lends itself to wide dissemination and the use of visual material is beneficial for researchers who wish to carry out further practical work in this field and need to understand some of the practicalities involved.

The thesis (Whiteley 2000) was examined in December 2000 and the degree of PhD awarded with no amendments required.

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