

## 6 Conclusions

*“The Chinese character for problem is a combination of ‘danger’ and ‘opportunity’. Every problem is the birth pang of a new solution. If that sounds overly optimistic, remember that every solution is also the birth pang of a new problem.”*

Guy Browning, How to ... solve problems (*The Guardian* 30.9.06)



*Figure 88: The craft practitioners who participated in this research, Robin Wood (top), Jeremy Atkinson (bottom).*

In this chapter I present a summary of my research, providing a general overview of the thesis and brief synopsis of each chapter. I describe the contributions this research makes to knowledge in the fields of multimedia design, learning and pedagogy, and specific areas of craft skill. Finally I discuss the limitations of the research and outline my plans for post-doctoral research which aim to address these issues.

### 6.1 Summary of the research

In this research I have taken a practice-led designer’s approach to explore the problem of how to understand and transmit the practical knowledge of skilled craft practitioners. This has involved two practical research projects during which I developed techniques for eliciting craft knowledge and refined previously established principles for the design of multimedia resources to support the learning of such skills. Drawing on the theories of Polanyi, Dewey and Schön, I have developed a framework for understanding how craft skills are learned, validated through reappraisal of the documentation generated during the practical work.

Practice-led design research is fundamental to my methodology and integral to this is my dual role of designer-researcher. The working of the dual role is explained through Polanyi’s theory of indwelling, whereby theory becomes interiorised and only known through its

embodiment in action (1966 p17). To assist with empathic indwelling<sup>37</sup> I recruited a group of close associates as participants in the research. To document the practical work and act as a stimulus to reflection I used extensive video recording and wrote 'event logs' to catalogue the video. This is effectively the reverse of interiorisation, where attention is returned to the theory governing the actions, and Polanyi regarded the process as being important to bring about deeper understanding of the actions, although it can temporarily paralyse the actor until the knowledge is subsequently re-interiorised (ibid p19).



*Figure 89: Bowl turned by Robin Wood.*

In the first practical project undertaken with the bowl turner Robin Wood, I experimentally used a systems-orientated approach involving three stages: knowledge elicitation, representation and application. My experiments with use of established elicitation techniques based on the practitioner describing his actions revealed knowledge which was too advanced for a beginner and my attempts at probing into this knowledge were either dismissed or responded to defensively by him. An observation-based technique produced more suitable starting material and I used a series of prototype learning resources as a means of representing my developing understanding of the elicited knowledge, structured using the framework developed during my MA research (Wood 2003). Application of the knowledge took place through a series of exploratory sessions with a small group of learners based on their using the developing prototype resource to support their learning, although I also frequently drew on my own knowledge and involved the craft expert to assist with interpretation.

I have set out to convey this first practical project in a realistic manner, not concealing the difficulties that occurred, the plans that went awry, my improvisation and modification. This is to emphasise the exploratory nature of this work. Gedenryd (1998 p152) makes this differentiation between experimental and exploratory use of prototyping in design, with the former being primarily concerned with testing the design itself and the latter considering a wider range of possibilities without a specific goal. For example, having allowed one learner to become exhausted and demoralised through freestyle

<sup>37</sup> My term for dwelling in another's actions, see section 2.2.2, p16.

experimentation, I felt the need to intervene and assist another learner rather than leaving her to struggle with inadequate interpretation<sup>38</sup>. I could do this with the knowledge that the ever-running video camera would capture my actions and after the event I could review and reflect on their outcomes.



*Figure 90: Clogs made by Jeremy Atkinson.*

In my second practical project with clog maker Jeremy Atkinson I developed a less intrusive elicitation technique based on increasingly focussed observation and interviewing. This resulted in a more cohesive piece of elicitation in which I gradually came to a wide-ranging understanding of the craft: the tools, materials and techniques used; and the principles of form and function in clogs. Whilst a limitation of this project was that I did not have the opportunity to validate the elicited knowledge with learners, I subsequently undertook a deeper investigation into the practitioner's understanding of the traditional usage of timber. This revealed how, having discovered a successful technique, he had found no need to re-examine his previous problems so his espoused theory was highly context-specific.

The result of this was to highlight the importance of the interplay between representation and validation of elicited craft knowledge in learning resource design. It would not be possible to investigate the 'truth' of *all* elicited knowledge and, as such investigation could also lead to defensiveness from the practitioner, it could also be inadvisable. The designer would need to validate any interpretation they create for the learning resource and other material generated during elicitation should retain its original context whenever possible so the learner can form their own judgement and make their own interpretation.

In the light of the outcomes from the practical work, I reconsidered the current context for craft knowledge and developed a framework to understand how it is learned. I firstly surveyed the decline and revival of clog making skills over the last century, partly by drawing on material recorded with the clog makers and partly through literature review, and this revealed the difficulty in resurrecting such crafts given such a small community of practice. To provide a context for

<sup>38</sup> see section 3.4.3.2, p66.

understanding the learning of craft knowledge I drew upon three major theorists: Michael Polanyi and his theory of tacit knowledge, John Dewey and his theory of experiential learning, and Donald Schön and his theory of reflection. I reassessed the learning I observed in the practical work in the light of these theories and proposed a framework for understanding such learning. The guidance offered by an expert can be seen as a series of 'bridges' that give the novice the opportunity to access the personal knowledge of the expert. The bridges are not necessarily *the* way to undertake the task, but *a* way that the expert feels to be helpful to get started. As their skill develops, the learner might find some of these to be the foundations upon which their skill is built, but some might be just stepping-stones on the way. Deciding which is which requires the learner to increasingly learn from experience, the feedback from their own actions, and this is achieved through developing the ability to think and act reflectively, moving through the modes of reflection described in section 5.5.2.

## 6.2 Contributions to knowledge

This research makes three specific contributions to knowledge. Firstly, in the field of multimedia design, it establishes a methodology for transmitting craft knowledge refining principles previously published through my MA research. Secondly, also in the field of multimedia design, it establishes techniques for eliciting craft knowledge which are interwoven with the process of developing the transmission resource. Thirdly, in the field of learning and pedagogy, it establishes a framework for understanding craft skills learning drawing on the theories of Michael Polanyi, John Dewey and Donald Schön and validated through appraisal of the practical work undertaken. In addition, in the field of craft practice, it has established specific knowledge and resources for the learning of traditional bowl turning and clog making.

### 6.2.1 Learning craft knowledge

The framework I have developed for understanding the learning of craft knowledge draws firstly on Polanyi's theory of tacit knowing. This proposed that such knowledge was personal, built up from a range of knowledge that the person in the act of knowing has, and was largely internalised so the theory governing actions was often only known through undertaking the actions (1966 p17).

Polanyi described the means by which such knowledge was learned as a process of indwelling: the novice seeks to dwell in the actions of the expert through observing them and taking action to imitate them (1966 p30). However, my work with the bowl turners showed that at an early stage of learning it was very difficult for a novice just to observe and imitate successfully. All the learners struggled to imitate what they had seen in the videos and one learner, Giles, when he chose to experiment with very little guidance became exhausted and demoralised. The bowl turning novices who made a more successful start to their learning used guidance in the form of my interpretation of knowledge elicited from the craft expert. This interpretation helped the novice dwell in the expert's actions by offering explicit concepts as a bridge over the gap

between their personal knowledge:

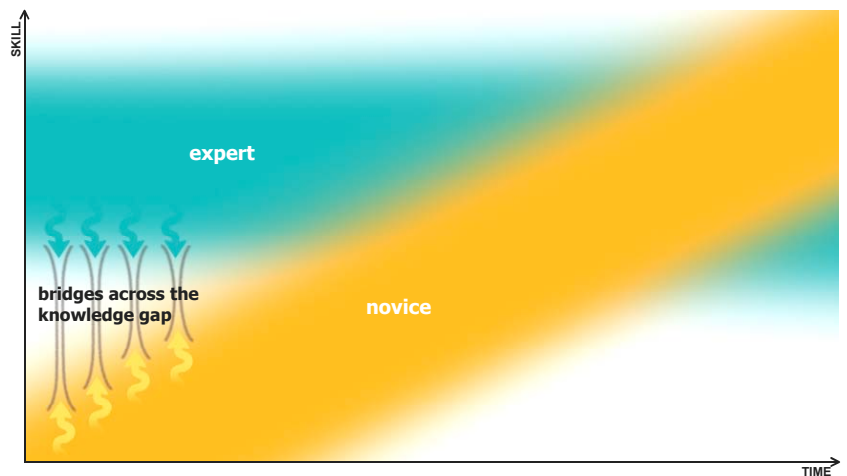


Figure 91: The knowledge gap between craft novice and expert.

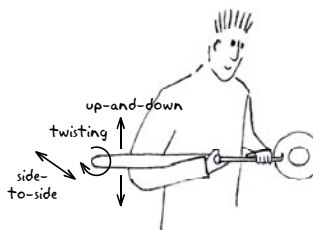


Figure 92: The three movements of the turning tool described by the expert.

For example Robin Wood, the bowl turning expert, used a series of explicit concepts to try to communicate to a novice how to achieve the correct angle so the turning tool cut cleanly. His first explanations were in terms of 'twisting' and 'pivoting' the tool, but the novice found the language confusing, so he tried again in terms of the angle of the tool: showing where  $90^\circ$  and  $0^\circ$  were and telling him to aim for  $10^\circ$ . The novice was then more successful, but Wood was not entirely satisfied and later came up with a new explanation, dividing the movement into three which subsequently proved more successful in conveying the concept to the novices<sup>39</sup>.

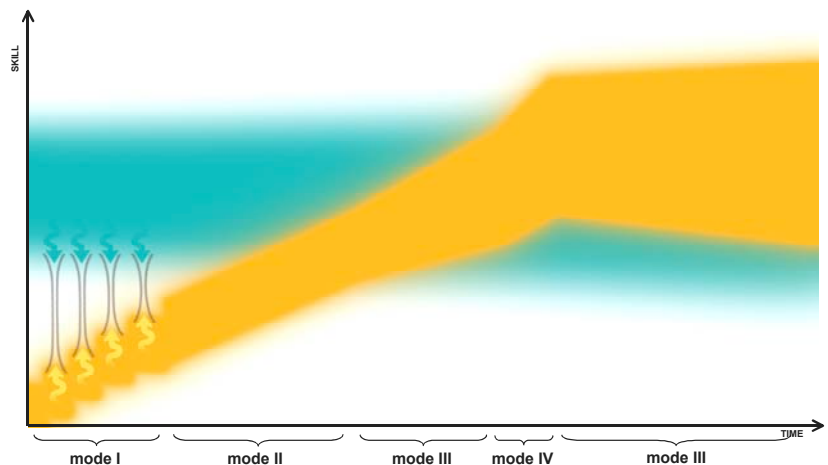
I am very concerned in this description *not* to imply that the tacit knowledge of the expert was made explicit. In my understanding, the knowledge that guided the angle at which the expert used a tool was largely internalised and could have been influenced by a rich variety of factors with varying degrees of importance. More obvious factors might include the type of timber being used, the moisture content of the timber, the sharpness of the tool, the type of bowl being turned, but there could also be personal factors such as the height and strength of the turner or just that he was rushing to complete an order or taking it easy because he was tired. At one stage when I was observing him, Robin told me that he had altered the tool angle because the wood shavings were spraying in his face. These factors are not the expert's tacit knowledge, they are explicit concepts which can help the expert

<sup>39</sup> My role in this process is described below.

articulate his tacit knowledge.

To understand the means by which a learner makes use of such knowledge from an expert and builds their own personal knowledge I draw on Dewey's theory of experiential learning. Dewey considered an experiential continuum to be important to the learning process, with the learner's skill progressing through a series of successive thoughts, each building on the previous and moving towards a goal. Schön elaborated on this concept, suggesting such advancement occurred through a reflective process, and identified different modes of reflection: reflection on action, reflection in action, and double loop<sup>40</sup> reflection. Whilst it was not always easy to clearly identify modes of reflection in the bowl turning learners' actions, particularly reflection *in* action, the two most successful learners both seemed to progress from predominately using reflection *on* action to increasingly using reflection *in* action. Double-loop reflection was only encountered in discussion with the craft experts and appeared to be an occasional, 'break through' occurrence, and long-term reflection in action appeared to predominate leading to the theory governing their actions becoming increasingly internalised.

*Figure 93: Idealised learning path using all modes of reflection.*



The two bowl turning learners who showed most significant skill development at first predominately used reflection on action: with Helen pausing frequently to ask for help and Andy alternating between working at the lathe and seeking assistance from the learning materials. They then spent an increasing amount of time turning, with

<sup>40</sup> This is my term for a concept developed by Schön and Argyris, see p135.

Helen's reflection in action shown through her comments as she noticed and corrected errors whilst she worked, and Andy's implicit in the steady improvement to his technique. Giles commented that taking a short break had been useful in providing him with time to think about the learning materials he had seen and afterwards he was able to think much more as he was working.

Examples of double loop reflection were described by both craft experts. The clog maker, Jeremy, described a discussion early in his career with a retired clog maker which led him to work in a very different manner with a different timber (section 4.3.1 p92). The bowl turner, Robin, related watching another turner using one of his tools in a completely different way and suddenly realising it was a very useful technique (section 5.4.4 p126). However, reflection in action appeared to mostly predominate, leading to their knowledge becoming very internalised. It proved difficult to get either craft expert to re-examine his espoused theories: notable examples are the reluctance of Wood to accept that he held the tool differently to the way he recommended, even after observing himself on video (section 3.4.3.1 p63) and Atkinson's understanding of the use of timber being based on his early bad experiences with unseasoned alder (section 4.3.2 p95)<sup>41</sup>.

In the light of this concept of learning craft knowledge, the terms 'elicitation' and 'transmission' take on a subtly different meaning from usual, moving away from the connotation that knowledge can be extracted and passed from one person to the next, and they are explained in more detail the next two sections.

## 6.2.2 Transmitting craft knowledge

The techniques I have developed for designing interactive media to support transmission of craft knowledge are embedded in the learning resource framework published in my MA research (Wood 2003). Whilst the framework has not changed significantly since publication, this research has both tested the structure and provided significant insight

<sup>41</sup> The difficulty this caused with corroborating elicited knowledge and overcoming this problem is discussed in section 6.2.3, below.

into how such a learning resource can help the learning of craft skills.

As described above, my experience of working with craft practitioners leads me to believe their knowledge is largely personal, context-specific and tacit. Transmission of such knowledge occurs through empathic indwelling where the novice dwells in the actions of the expert through observing and then re-enacting them (Polanyi 1966 p30). The role of the learning resource is to support the empathic indwelling of the novice through three phases of learning:

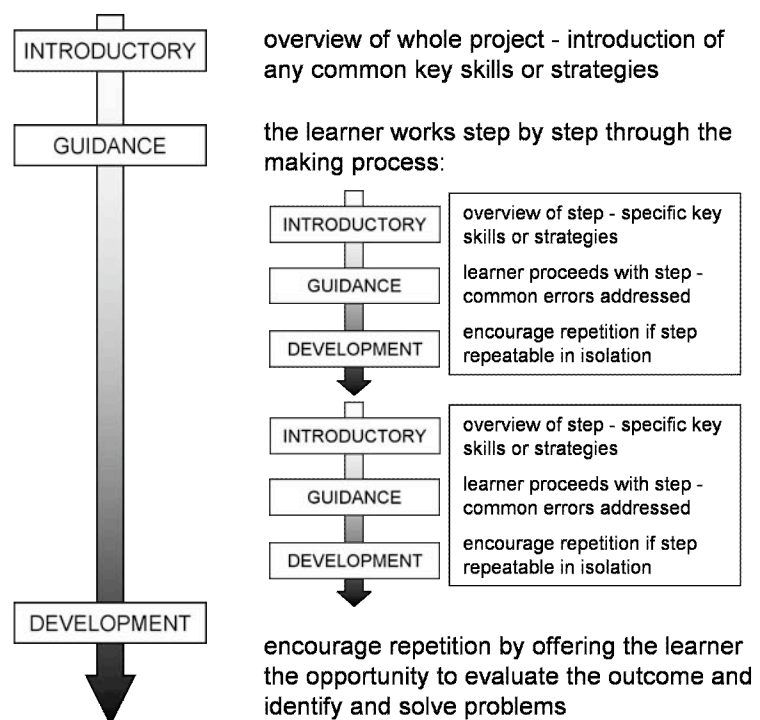


Figure 94: Overview of learning resource structure.

This framework was used to structure material supplied to the bowl turning novices in the first part of the practical work I undertook. Firstly, at the introductory phase they were provided with an overview of what they were trying to achieve, usually in the form of a short video clip, and introduced to any key skills or strategies. However, the novices initially struggled to use what they had seen in either live or videoed demonstrations to inform their learning, demonstrating their need for the guidance phase. This took them step-by-step through the procedure and explained any common errors associated with them. This supported their early use of reflection on action as they attempted to relate the feedback from their experiences to the interpretation, alternating between lathe and learning materials as they learned. Two novices then spent increasing time at the lathe showing steady

improvement to their technique, giving indication of an increasing ability to reflect *in action*.

Whilst this project was too short to allow much time for skill development, the learning resource could further support the novices in their development phase once they had developed the ability to dwell in the actions of the expert without needing explicit interpretation, through offering a wider range of video for them to draw from and this will be explored further in my post doctoral research described in section 6.3.

### 6.2.3 Eliciting craft knowledge

Given the framework for understanding the learning of craft skills described above, the process of elicitation can be seen as helping the expert craft practitioner articulate his knowledge. My role as designer-researcher was to both to encourage this articulation and to design the 'bridges': the explicit concepts that could help a novice access the expert's tacit knowledge. Integral to this process was a prototype learning resource based on the structure described above, which enabled me to work with novices to develop and refine the interpretation.

The elicitation technique I developed was successfully used to help clog maker Jeremy Atkinson articulate his knowledge. It was based on a combination of observation and interviewing, a process of gradual immersion starting with general observation and open questions aimed at gaining contextual information, and then gradually increasing the focus of observation and questioning as my understanding grew. The elicitation sessions were almost entirely workshop-based allowing me to observe his regular practice and enabling him to illustrate his explanations through demonstration.

The technique of working with an expert to design the 'bridges' to allow novices to access his knowledge was demonstrated in the example described above where I helped Robin Wood, the bowl turning expert, articulate his knowledge of how to achieve the correct cutting angle of the tool. During the formal, experimental elicitation I had undertaken I had failed to understand his technical explanation using

angles. When trying to help a novice understand the concept, he regularly resorted to twisting the tool in the novice's hand into the correct position as he could not find a verbal means of communicating what he wanted. He again tried the explanation using angles, but the learner also struggled to understand it. However, after this experience he came up with the notion of dividing the movement into three which he demonstrated for me to record on video. Whilst this explanation was hesitant, it was sufficient for me to gain an understanding and then to use the prototype learning resource to develop interpretive drawings. These helped the learners gain experience of the correct cutting angle of the tool as a starting point for building their own personal knowledge of tool use.

The novice played an important role in this process and I draw on Schön's concept of reciprocal reflection in explanation. Schön suggested that it required intelligent effort on behalf of both expert and novice to bridge the gap between the two. So, as well as the novice acting reflectively when offered guidance by an expert, the expert too needs to reflect on the resultant actions of the novice and consider revision of the guidance until the two reach accord. Working with the novice appeared to help Wood reflect on his explanation of the cutting angle of the tool. As the novice struggled to respond to his guidance he tried both modifying his explanation and physically putting the tool at the correct angle. Whilst this reciprocal reflection was not entirely satisfactory as the novice continued to struggle to use the tool, afterwards Wood continued to reflect on the experience until he developed the explanation which I was able to use successfully. I plan to make further use of novices to stimulate reciprocal reflection in future research, as described below.

#### 6.2.4 Material to support craft learning

In the practical work with both craft experts I generated significant video footage of both their regular practice and their descriptions of their practice. Whilst I did not have the opportunity to develop material with Jeremy Atkinson to support novice clog makers, the footage of him will be of value to more experienced learners and will be held in the archive at the Museum of Welsh Life so it will be publicly

accessible.

In the practical work with the bowl turners I helped the expert, Robin Wood, articulate some of his knowledge to develop interpretation for a learning resource. Since participating in this project he has taught several short courses and successfully used these explanations in his teaching. Whilst the interactive learning resource is currently only partially complete, I plan fill out the missing sections and make it available to Robin's course participants to support their subsequent skill development.

## 6.3 Limitations and future directions

### 6.3.1 Knifemaking project

The immediate impact of this research on my own work has been to provide me with a clear understanding of the process of transmitting craft knowledge. It has provided a methodological underpinning for the recording work I have been doing and I plan to continue producing archive and learning material for traditional craft practices. I have planned a two-year post doctoral research project<sup>42</sup> which will enable me to continue this research and explore possible solutions to some limitations I have identified which are discussed below.

In the first practical project with the bowl turners I chose a group of participants and a craft of which I had close acquaintance to help me dwell in their actions and understand my observations. Whilst the second practical project was a partial step away from this, working with participants and a craft less known to myself, it was still within the realm of woodworking of which I have specialised knowledge that I drew on during elicitation. In my post-doctoral research project I shall be studying the skills of a number of traditional knife makers, a craft of which I have no prior knowledge. I shall be using a contemporary knife maker who will act as an 'expert learner', working alongside and learning from the traditional craftsmen, with the aim of stimulating reciprocal reflection to aid elicitation and interpretation.

Whilst the event logging process I used, running the video in QuickTime and writing the log in Word, was sufficient for cataloguing the bowl turning learners, it proved increasingly cumbersome and slow with the large amounts of video generated recording the clog makers. Since I started this research new video analysis software has been developed primarily for use in social science research which offers the potential to streamline the operation. At the production stage the software can manage both operating the video and writing the log

<sup>42</sup> "Transmitting Craft Knowledge: eliciting and passing on the skills of craft masters with the help of interactive media" AHRC award number AH/D001838/1 awarded 17/5/06.

rather than having to switch between two programmes. It also offers a more efficient catalogue for later use as the video is automatically bookmarked when an event is logged, so can easily be located and reviewed.

There was not time during this research to fully develop and test an interactive learning resource. There are specific elements I wish to investigate more thoroughly, such as the use of narration alongside text and video, and I wish to observe more advanced learners who have a greater ability to dwell in the actions they are observing to help structure the development phase (see Figure 94). In the knife making project described above I plan to produce a fully functional resource and test it with a wider range of novices who will use it to support their ongoing learning after being initially taught by the 'expert learner'.

Finally, I did not have the opportunity to explore the social aspect of learning in either practical project. Looking back at the short courses I observed as part of my MA research, the relationships between learners on the courses appeared to be beneficial to their learning, offering different but still useful support to that offered by the craft expert. Literature from the field of education (e.g. Vygotsky 1962, Lave and Wenger 1991) highlights the importance of the community of practice to the learner and I plan to further explore this aspect with the knife making novices.

### 6.3.2 Wider implications

This research has had a wider impact on other areas I am involved with, in particular recent work I have undertaken with Robin developing short courses teaching hand carving with knives and axes: a craft we have both practiced for many years (see Figure 95) but have only recently started to teach.



*Figure 95: Eating spoons made by myself and Robin*



*Figure 96: A student practicing a knife grip.*

The structure of these courses has been based on the learning resource framework<sup>43</sup>, using the three phases: introductory, guidance and development. Key skills, such as different hand grips on a knife whilst carving, have been taught firstly in isolation, getting learners to whittle a stick away to nothing (see Figure 96), before they apply them by making a spatula. I have designed a simple spatula that is easy to carve and the students are encouraged to replicate this to learn the key skills before producing their own designs which inevitably call for more advanced skills.

Whilst I have been occupied completing this research, Robin has been delivering the teaching, but over the next year I plan to lead some workshops myself with a particular interest in encouraging women makers like myself who frequently need to adapt techniques to make up for lack of strength.

In addition, I believe the project has broader implications for learning in the crafts and I am exploring ways to translate the principles of elicitation and learning for application in mainstream education, for example involvement with metal workers and ceramicists on undergraduate courses.

I would speculate that this understanding of craft learning and the model of apprenticeship I have developed could have applications not purely in the immediate area of the crafts but also in any area where tacit understanding needs to be developed. It leads people to attend to the tasks and activities of professional work, not purely as a means to

<sup>43</sup> see Figure 25 p44

a practical end, but as bridges to a richer understanding of the practice. I am already aware of others who know my work using the bridging concept in explanation of their own work and, through further dissemination, I plan to make the theory more widely accessible for further adaptation.