

3 Practical work I: bowl turning

“Boys won’t learn work like this now,” he said. “It’s not as easy as it looks and unless you learn when you’re a lad you can never catch the knack of it.” He uncovered a pile of beautifully turned bowls of all sizes in a corner of the hut ... each bowl had the individuality which only a man’s hands can give to an object.

George Lailey, interviewed by H V Morton, *In Search of England* (1930).

3.1 Introduction



Figure 12: Traditional bowl turner, George Lailey.

The aim of this practical project was to work with an experienced craft practitioner to explore the tacit knowledge within his practice. This involved using a series of video recordings and interviews to promote cycles of reflection and interpretation, allowing the practitioner and designer-researcher to examine techniques and recognise variations. In each cycle of the research a developing prototype learning resource was used as a tool for recording and, with the assistance of a small group of novices, evaluating what had been discovered so far and investigating deeper layers of the problem.

In this chapter I present the findings under three headings: elicitation, representation and application. This is done to reflect my original, systems-orientated approach, which was an iterative process of knowledge elicitation through observation and interviews with an expert, representation through development of a learning resource, and application through testing an exploratory prototype with a group of novices.

During the course of this practical work I increasingly stepped outside these boundaries in response to unfolding events. Whilst primarily unplanned, these judicious interventions show the developing role of designer-researcher as described in the Methodology chapter (see p16). Through the process of video recording and event logging they

were documented and made use of in subsequent appraisal and reflection. Although using these three key concepts as a means of describing the practical work creates some repetition, I feel it provides a clearer picture of the theoretical background to this work than presenting events sequentially.

The systems-orientated approach had its origins mainly in the related fields of cognitive task analysis and knowledge engineering that employ similar methods for accessing 'expert' knowledge, although they can be aimed at different outcomes. Cognitive task analysis is the study of the mental processes that organise and give meaning to observable behaviour and has been developed in the field of cognitive psychology. The aim is to improve performance of a task through understanding and supporting the cognitive activities involved (Potter *et al* 2000) and it is used for a broad range of applications such as developing training resources, assessment criteria or profiling for recruitment purposes, so the outcome is not necessarily computer-based (Militello & Hutton 1998). Knowledge engineering, with its roots in computer science, is specifically focussed on developing computer systems. The development of 'knowledge based' or 'expert' systems has moved on from the rather grandiose aim of creating artificial intelligence and now more simply aims to create machines that are "able to emulate some of the behaviours of a human domain expert" (Diaper 1989 p20).

From this perspective, their main focus is on "the fundamental problem of being able to extract and represent the knowledge of the human domain experts" (Diaper 1989 p11), which is viewed as a bottleneck in the whole process. Whilst the idea that such knowledge could be 'extracted' is alien to me, the methods developed in these disciplines for knowledge elicitation provided a starting point for what I view as stimulating the practitioner to articulate his practical knowledge, as well as promoting reflection both in the practitioner and myself.

A prototype learning resource was used as a means of representing my understanding of the knowledge elicited. This was based on the framework I had developed during my MA research and implicit in this project was a continued test of it. The content was further developed in response to feedback from the novices and informed by literature on

the cognitive processing of graphic representation.

As a means of knowledge application I tested the developing prototype resource with a small group of learners and the account that emerges from this reveals increasing blurring of the boundaries between elicitation, representation and application. It shows the role of the designer-researcher in adapting to circumstances and performing frame experiments to make sense of the problematic situation.

Participants⁹

For this first stage of practical work I recruited a small team of participants from close acquaintances who I considered would be comfortable with the exploratory nature of the research. My aim was to help open up communication between the participants and myself and to make it easier for me to understand their actions through empathic indwelling¹⁰.



Figure 13: Craft practitioner, Robin Wood.

The practitioner whose skills formed the main focus of this project was my husband, Robin Wood who is a full-time professional craftsman turning wooden bowls on a foot-powered pole lathe. He had regular experience of demonstrating his craft to the public and being interviewed by journalists so was comfortable with being filmed and questioned as part of the research. However, he was entirely self-taught and his experience of teaching others was very limited, so communicating his practical skills in a way that would be of assistance to someone wanting to learn them was new to him.



Figure 14: Bowls turned by Robin Wood.

His craft gave a discrete problem to examine because, although the whole process from selection of timber to drying and finishing the bowls is time-consuming and complex, it is possible to learn the turning skills in isolation. Whilst the process is short, the hand-forged hook tools offer sufficient complexity; describing how the curved edge of a tool meets the curved surface of a bowl is not easy, and subtle movements of the tool can greatly affect the cut.

⁹ I shall largely refer to the participants in this research by their first names as it makes easier reading, particularly in avoiding confusion between 'Wood' the practitioner and 'wood' the material he works with.

¹⁰ empathic indwelling is discussed in section 2.2.2, p16

The four bowl turning learners were self-selected friends of both Robin and myself. In addition to helping promote empathic indwelling, this also meant Robin was at ease with them in his workshop and was comfortable with teaching the learners directly when requested.



Giles [GB] had learned general wood working skills from helping Robin to make outdoor furniture, but had no prior experience of turning. He had volunteered to participate primarily because he was keen to learn how to turn, but he was also interested in the research having undertaken some filming on an earlier project.



Helen [HS] had no prior experience of woodturning but had previously learned the basics of throwing pottery by working for a few days alongside an experienced potter then experimenting on her own. A major issue which I did not discover until we were in the workshop was that Helen was left-handed and it was not possible to adjust the lathe to enable her to hold the tool that way around. She said she was happy to try turning right handed as she had learned to throw pots right-handed¹¹.



Mick [MK] had experience of turning about fifteen years ago using a treadle lathe on which the turner provides the power in the same way as a pole lathe. However, the treadle is attached to a fly-wheel which gives the work continuous rotation whereas with a pole lathe the work turns back and forth and the turner only cuts when depressing the treadle. Whilst his job and hobbies involve little manual work, he is a keen runner and cyclist so is physically fit.



Andy [AB] had some experience of using a pole lathe but using a spindle turning technique that involves different tools and techniques to bowl turning. He is both physically fit and strong as he works for the local National Park footpath maintenance team.

Figure 15: Bowl turning learners (from top) Giles, Helen, Mick & Andy.

¹¹ Robin has studied many hundred Medieval and more recent bowls turned on such a lathe and has not found one that he feels could have been turned left-handed.

Workshop procedure



Figure 16: Robin Wood's house (foreground) and workshop (background).



Figure 17: Video camera on the workshop door.

Robin's workshop is just next door to our house, so I had the opportunity to experiment with using the recording equipment in different conditions, and to set it up to my satisfaction before starting filming each time. The initial observational videos of Robin turning were hand held so I could easily move to capture the action without constraint. I framed shots using the camera's external LCD screen so it could be held relatively unobtrusively at a lower level, rather than in front of my face using the viewfinder.

The sessions with learners were video recorded in their entirety then event logs written to promote immediate reflection and provide a catalogue for future use (see section 2.3.2, p22 for a full discussion). To enable my attention to be focussed on participating, I filmed from a fixed point, attaching the camera to the workshop door with a g-clamp mini tripod, and used a wide-angle lens so most of the workshop was in view. This also enabled the camera to be plugged into an external power supply so I had no concerns about changing batteries. Other than changing the tape every 90 minutes the camera needed no further attention.

After reviewing footage of the first learning session with Giles I had to make several changes to the recording set-up. Firstly, I had used the camera's internal microphone, but found this suffered from wind noise, as the front of the workshop was open to the elements. As there was not an alternative position for the camera that would capture all the action, for subsequent recordings I successfully used an external microphone taped in a sheltered place on the doorjamb.

Secondly, the only light in the workshop came from the open doors, so I initially provided additional lighting with a spotlight that both increased my set-up time and during filming was intrusive from some positions in the workshop. However I could not see a significant improvement in the video quality over the initial observational videos of Robin that were unlit, so did not use additional lighting for subsequent recordings.

Finally, to give access to the learning resource video in the workshop, I had initially placed my laptop on a bench opposite the lathe in full view

of the camera. However, as soon as Giles started turning it became apparent in this position it would get sprayed by wood shavings so I moved it, unfortunately virtually out of the camera's view. Thereafter, I made room for it on the shelf behind the lathe which, whilst not at such a good camera angle, was both safe from the shavings and in a better position for the learners to access it.

Once these issues were overcome I felt able to participate fully with limited intrusion from or interruption by the recording process. The learners rapidly acclimatised to the presence of the camera and showed no sign of self-consciousness in front of it. When at times I left them to work alone in the workshop they readily agreed to manage the camera themselves, switching it off if they left the workshop for a break and back on when they returned.

After each session I processed and reviewed all the tapes, creating event logs both to stimulate immediate reflection and as a catalogue for future access to the recordings.

3.2 Elicitation

3.2.1 Introduction

In this section I describe my initial work with bowl turning practitioner Robin Wood, starting with a review of the formal knowledge elicitation techniques used in such fields as cognitive science and knowledge engineering. I then relate my experiments with several techniques based on the practitioner describing his actions in an attempt to elicit material for the learning resource. The resultant knowledge I felt was too advanced for an absolute beginner, so I used an observation-based technique to form the first tentative prototype learning resource.

Whilst these purposeful interviews and observations provided much useful material, they produced only part of the elicited knowledge. More was revealed through subsequent work with the novices and this is related in the Application section (p59).

3.2.2 Context

The first stage of the practical work aimed to gather sufficient basic knowledge to produce a paper-based prototype of a learning resource. As I was seeking to explore skills that the practitioner would find difficult to articulate, I was looking for specific methods to stimulate that articulation and help the practitioner and myself to reflect on his practice. Cordingley (1989), Cooke (1994) and Edwards (2003) provided overviews of knowledge elicitation techniques from a wide range of fields including psychology, business management, cognitive science and knowledge engineering. Each used different systems of classification to group the vast array of techniques, but those relevant to this research described here fell into three groups: verbal reports, observations and interviews.

Verbal reports aim to access the cognitive processes behind actions and can be carried out either on-line, with the reporter talking as they work, or off-line where the reporter comments retrospectively on their performance, often prompted by an audio or video recording (Cooke 1994). Positive aspects are that the reporter steers the process (Edwards 2003) and that it can be carried out concurrently with the

task being studied, although this in its own right might impair performance (Cooke 1994). However there are many limitations to the processes such as being reliant on how articulate the reporter is (Cordingley 1989), that the reporter might not talk about what seems obvious to them or they might alter their performance because they are aware they will have to describe it (Cooke 1994).

Observation is identified as a powerful tool, particularly in gaining an initial overview of the area of study (Cooke 1994). At one end of the spectrum, with a high level of elicitor involvement, is active participation where the person eliciting the knowledge plays an active role in the practice they are observing, which is deemed useful for gaining insight into social practice, but the results can be difficult to interpret. At the other end of the spectrum, observation can be arranged to have minimal interference with the practice, although the elicitor must remain aware that their very presence might affect the practitioner (Cordingley 1989).

Interviews, whilst being some of the most commonly used methods, have the disadvantage that they are usually retrospective, and reliant on the interviewees' recall of the situation. At the unstructured end of the spectrum they can be useful for establishing rapport and providing a broad view of the domain, although they can "produce copious, unwieldy data" (Cooke 2004). Structured interviews, being more systematic can provide more manageable data, but require a greater knowledge of the domain so can be very time-consuming to prepare (Edwards 2003).

Had I not already been so familiar with the craft, I would have planned to start with an initial period of observation to give myself an overview before starting more formal elicitation. As it was, I decided to go straight into a comparison between on-line and off-line verbal reportage as a stimulus to reflection and then use issues arising from the reportage as a basis for semi-structured interviews with the aim of being able to probe more deeply into the practitioner's practical knowledge. This elicitation yielded what I felt was quite advanced knowledge for a learner and I needed to return to detailed observation to see it anew before being able to make the first tentative representation of the knowledge.

3.2.3 Practical work

Over a period of three weeks I experimented with three different elicitation methods with Robin Wood, each of which was concluded with a semi-structured interview.

Firstly, during the course of a day I undertook two experiments with verbal reportage aimed at providing a comparison between on-line and off-line verbal reportage (Cooke 1994). The task of turning a bowl naturally divided into two parts, shaping the outside and hollowing the inside, involving what the practitioner Robin Wood considered to be related but slightly different skills. So, firstly we used an off-line reportage technique, stimulated recall, concentrating on shaping the outside of the bowl, and then an on-line one, concurrent verbalisation, concentrating on hollowing the inside. Issues arising from each reportage session were used as a basis for semi-structured interviews held immediately afterwards with a view to probing more deeply into the practitioner's practical knowledge.

Whilst the reportage and interviews provided insight into the areas of the practitioner's skill he could easily articulate, I felt the overall focus was probably pitched too high for a complete novice. As background research to the skills needed by a beginner, I filmed the practitioner's normal practice, turning complete bowls from start to finish, over several consecutive days. After consideration of the differences and similarities in these recordings, I used another semi-structured interview to gain direct feedback from the practitioner regarding the initial content to be used in the resultant prototype learning resource.

The work presented here was by no means the end of the elicitation process, but the only discreet part that could be represented as such. The remainder is described in the Application section (see p59) where the boundaries broke down and designer-researcher, practitioner and novice became involved in the process.

3.2.3.1 Stimulated recall

The first part of the task, shaping the outside of the bowl, was examined using an off-line technique, stimulated recall, where the



Figure 18: Still from the 'stimulated recall' video.

practitioner was filmed undertaking his normal practice. Immediately afterwards he reviewed the recording and commented on his performance, and this too was filmed to provide a record of what was said. A semi-structured interview was then conducted, based on issues raised during the elicitation.

I videoed Robin turning the outside of a bowl at his normal production speed with no discussion or comment, which took just over five minutes. Immediately afterwards I transferred the video to a computer so it could be easily reviewed in a non-linear manner without having to spool through the tape. Robin and I then watched this recording together and discussed our observations, which in its own right was videoed to allow later appraisal.

The initial discussion lasted just over twelve minutes, during which time Robin talked in reasonable depth about what he could see happening, but had a tendency to be defensive or dismissive when I asked questions. For example, after the first two minutes I asked if he was still using the same tool that he started with, feeling fairly sure he had changed tools. He dismissed the suggestion and continued with his interpretation. Concerned that he was totally absorbed with trying to keep his pace of interpretation up to the speed of the video, I used the excuse that I could not see the screen clearly to ask him to pause and review the video again. He then suggested that he paused the video when he spoke and we resumed watching the video on this basis. After a further five and a half minutes he independently realised he *had* changed tool and we searched back in the video for when he did so, although at this point he was not very forthcoming as to why.

However, removing the pressure of trying to keep pace with the video did not help with my questioning and attempts to probe deeper were still largely unsuccessful. For example, in the observational video Robin could be seen regularly stopping turning to inspect the surface of the wood and as he did so he always ran his fingertips over the surface too. On four occasions I suggested that the sense of touch played a part in this inspection, but he constantly denied or avoided the issue:

01.02 NW: *You can just see those bumps or can you feel them?*

RW: *You can tell when they've gone because of the noise it makes.*



Figure 19: The practitioner “pointing” at the wood.

01.15 NW: *That's what you're feeling with your hand?*

RW: *I was seeing them.*

NW: *Seeing them?*

RW: *Yes I turned it slowly round and I could see them ... and I could see how deep they are so I can see how much to take off in this cut here.*

01.27 NW: *You're also stroking it aren't you?*

RW: *Yes ... a little bit ... yes ... I'm pointing there at ... um ... I'm pointing there at where it needs to be cut off (see Figure 19).*

11.21 NW: *And there you're checking it ... is that visual or feel or both?*

RW: *It's mostly visual: you can see the tear out and I'm making an aesthetic decision on what quantity is OK.*

Robin Wood interview 7.1.04 [event log RW1 clip2]

My feelings about this observation were confirmed about a year later when I was asked if I could contribute material showing craft makers using their sense of touch for an exhibition at the V&A called “Touch me: design and sensation” (V&A 2005). In this context I asked Robin again about his use of his sense of touch and suggested to him he might provide one of his bowls to go with some of the research footage for the exhibition. He then talked quite openly about using his sense of touch to differentiate between the tear-out on the surface of the wood that needed to be removed and natural dark markings in the grain wood, which did not.

To overcome the barrier encountered during the initial interview and instigate a more open discussion I switched off the video camera recording our conversation, diverted attention away from the computer with the observational video and asked more open questions. Once Robin was into the flow of the discussion I found I could ask if he would mind recapping for the camera. He would then comfortably review and elaborate on the discussion, using the video on the computer and bowls he had previously made to illustrate his points.

The result of this session was that I gained a good overview of the part of Robin's skill that he could easily verbalise. This was fairly advanced use of tools and associated techniques: the use of different cuts (roughing, shaping, finishing), the basic feedback he was responding to (sound and sight), and some discussion of his aesthetic judgements.

3.2.3.2 Concurrent verbalisation

The second part of the task was examined using an on-line technique, concurrent verbalisation, where the practitioner was filmed giving a verbal report as he was carrying out his normal practice. Whilst research has identified that the additional cognitive load experienced by practitioners having to talk as they work can impair their performance (Cooke 1994), Robin felt this effect would be minimal as he was familiar with answering questions whilst demonstrating to the public and he was working on a standard bowl using familiar techniques. The issues raised by this elicitation were also used as the basis of a semi-structured interview.

Turning the inside of the bowl took just over nine minutes during which I decided to just listen and not pose questions to avoid the negativity generated in the previous session. Robin talked quite fluently, pausing frequently to re-cap what he had just done and explain what would happen next, rather than talking as he worked. The focus of the dialogue was the advanced use of tools and basic aesthetics, very similar in content to the stimulated recall session where Robin was explaining what he could easily verbalise.

To conclude this session, I again put this video footage onto the computer and we watched it together, video recording the discussion for subsequent appraisal. I was now able to undertake deeper questioning without triggering the defensiveness encountered during the early stage of the previous session.

For example, when asked in the first stimulated recall session why he changed tool at a particular point, the practitioner's initial response was that simply the other tool was sharper. When prompted for more detail, he modified this to the second tool cutting better, but this time did not offer an explanation as to why it was cutting better:

08.31 NW: *So, what's the difference between those two tools?*

RW: *There's no difference between those two tools - the difference is sharpness - this one's been sharpened more recently.*

NW: *So they are both quite big hefty hooks?*

RW: *They're a similar shape, but that one's cutting better ... you can hear it's cutting better.*

Robin Wood interview 7.1.04 [event log RW1 clip2]

In this second session following the concurrent verbalisation, discussion on a similar point revealed that the shape of the tool was also at issue and seemingly identical tools had very subtly different shaped cutting hooks:

03.42 NW: *The thing that I notice there is that with this tool ... you're cutting with the back edge with the curl sticking up, whereas with the other tool ... you were the other way up ... weren't you?*

RW: *Um er ... it ... er ...yees ...*

NW: *So if we go back to the beginning [scrolls back through the video] here ... then your tool is that way up, isn't it?*

RW: *Yes it is.*

NW: *Why?*

RW: *I think it's probably something to do with the way this particular tool is shaped. The very fine ... um ... that this point, the under ... underside edge is probably more in line with the shaft ... so ... and the result of that, and the very fine angle is that when you use it this way up it just pulls into the wood nicely, whereas if I turn it over then this back edge ... I think you can actually see it ... this line coming straight down here [pointing with the mouse on the screen]. The back edge would be more out of line with the centre of the shaft so you get more twisting motion so it doesn't pull itself into the wood in quite the same way.*

Robin Wood interview 7.1.04 appendix [event log RW1 clip 4]



Figure 20: A selection of Robin Wood's hook tools.

The outcome of this session I felt was knowledge at a very similar level to that revealed by the stimulated recall: a relatively advanced description of his techniques and a basic discussion of his aesthetic judgements. Whilst this would be of use to more advanced learners, I felt I needed to return my attention to regular practice with a view to finding assistance for the complete novice.

3.2.3.3 Focused observation

The next experimental elicitation session focussed on observing normal practice to identify basic skills for beginners and concluded with a semi-structured interview based on proposed content for a learning resource. On three successive days the practitioner was filmed undertaking his normal practice, turning a bowl from start to finish, with as little intrusion as possible from the recording process. In addition I explained before recording started that I was not looking for anything in particular and that I required no explanation or interpretation. The video was hand-held so I could change position easily to capture the action without constraint of a tripod, and shots were framed using the camera's screen so I could keep the camera low and relatively unobtrusive, rather than using the view-finder in front of my face.



Figure 21: Pear wood mazers, fine-rimmed drinking vessels.

The three bowls took thirteen, nine and sixteen minutes respectively to turn, with the first two being standard, straightforward eating bowls. As Robin started the third he commented, "It's a very uneven one this: the mandrel didn't go in the centre of the block," and he clearly experienced some difficulty both with the turning and the form. Later he commented that it had become a mazer, a fine-rimmed drinking vessel, so he had to spend more time tidying it up as it would sell for more money.

The three videos were transferred to the computer and compressed so all three could be run simultaneously on the screen to allow comparison. Considering them in the light of the commentary provided in the previous elicitation sessions allowed me to make a first attempt at separating the material into novice and advanced techniques and the drawing up of a preliminary sequence of key skills and critical steps to present to a new learner (see learning resource structure p44).

As a first test of the veracity of the content, I used it as the basis for a semi-structured interview with the practitioner. For speed and to minimise intrusion on the practitioner, I did not video it, but took written notes and then used these to draw up the preliminary resource (see prototype learning resource I, section 8.1). To avoid the problems that arose in the previous session with questioning causing

defensiveness, I kept my own interpretation hidden during the interview and asked the practitioner open questions regarding teaching of a theoretical novice to stimulate him to provide his own suggestions. Where I detected differences between the practitioner's theory and my own, deeper discussion was attempted by my pretending I did not understand, but not pressed if explanations were not forthcoming. I again checked the notes taken during the interview against the video footage previously taken. This clarified the critical steps I had identified with a few minor modifications, but raised a significant issue regarding key skills.



Figure 22: Handgrip with hand as a clamp.

Firstly, the way in which the practitioner described how the tool should be held was considerably different to what could be seen in the videos. Robin made very clear that he felt the tool should be held by using the hand as a clamp over the top of the shaft and also holding onto the tool rest as in Figure 22. Rather than sliding the tool along the rest, the tool should sweep the side of the bowl pivoting from a fixed point, then be moved along the rest a little, clamped by the hand again and another sweep performed.



Figure 23: Handgrip with hand in a fist.

Whilst this process could be observed when Robin was turning the inside of bowls, when turning the outside the tool was rarely held in this manner. Far more commonly Robin held the tool in his fist just behind the tool rest and slid his fist along the rest as in Figure 23. Secondly, even upon reviewing the video again, I could not gain a clear understanding of how to achieve more aggressive or finer cuts. Robin described it in terms of the angle at which the tool met the wood with 30 degrees being aggressive and 15 degrees being a fine cut, but with this being the description of two curved surfaces meeting each other, I found it a difficult concept to grasp. Further complication was added by many of the tools being sharpened on both sides and Robin using them both with the hook tip pointing downwards and upwards:

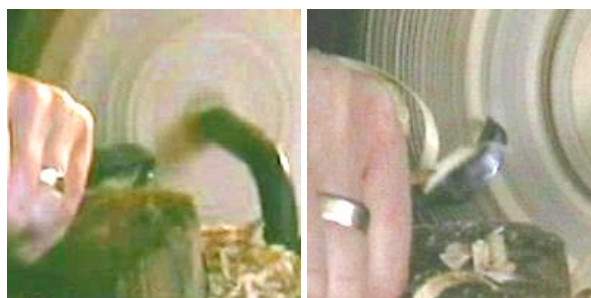


Figure 24: Tool used with the hook tip pointing downwards (right) and upwards (far right).

Whilst this was not an ideal outcome, I felt to have gained a good background to the issues a novice was likely to encounter and that further understanding could only be achieved through working with a novice.

3.2.4 Discussion

My initial response to the experiment comparing on-line and off-line verbal reportage was that they yielded similar results so could be used interchangeably depending on the preference of the craft practitioner. In this context, given the added complexity of stimulated recall: either the necessity of running two cameras or the time taken to import the observational video onto the computer and set the video camera up again to record the discussion, I felt concurrent verbalisation was the better option (Wood 2004).

However, when I attempted to ask more probing questions, the practitioner tended to either rebuffed my questions or respond in a defensive manner. As observed by other researchers in similar situations (Shadbolt & Milton 1999, Edwards 2003), when pressed into talking about elements that he did not have immediate answers for, the practitioner's initial reaction was to give quick responses that gave minimal insight into the situation. In addition, whilst the knowledge yielded during these recordings would be of interest to a more advanced learner, I felt it would be of limited use to a novice. This was later demonstrated by the novices' difficulties with using this video to help them hollow the inside of their bowls.

Overall these attempts at formal elicitation prompted the practitioner to display an instinctive protectiveness towards the complexity of his craft: attempts by myself at interpretation were viewed as over-simplification and instances where the video apparently contradicted the practitioner's interpretation were dismissed¹².

The focussed observation videos provided me with material that was of great importance to the remaining research process. Watching them

¹² This is further discussed in term of Argyris (2003) and practitioners' tendencies to preserve their espoused theories rather than seizing the opportunity to reflect on their theories-in-use, see section 5.3.4, p111.

gave insight into other uncertainties, such as understanding how the tool was held at different stages, stills were taken and used to illustrate an early stage of the prototype learning resource, and the clips themselves were edited and used as 'video sketches' in the resource. However, it was not until both the practitioner and I started to work with a novice that we could focus on what it was that a novice needed.

3.3 Representation

3.3.1 Introduction

In this section I present the context for the representation of the elicited knowledge, starting with a summary of the structure developed in my MA research for an interactive learning resource to support the learning of craft skills that was used as a basis for this project. In addition I provide a review of literature relevant to the representation of the content for this resource starting with a review of notation methods used to record dynamic movement in such fields as dance and choreography.

Whilst such notation was not eventually used, it provided a basis for considering terminology and a means of representation that self-directed novices could pick up quickly. In this context, I provide a review of literature that considers more broadly the use of representation in multimedia learning resources, in particular the use of animated graphics and their observed failure to demonstrate an advantage over static graphics. As an alternative, cognitive design principles are shown as a means that have been used to combine different modes of representation to afford effective learning.

I describe the practical work undertaken showing use of the learning resource structure and the development of the content for it¹³. In particular I describe the development of a 'sketch-and scan' technique to generate static illustrations to interpret video material. I conclude by considering further use of commentaries in future research and reflecting on the learners' responses to animation in the form of video.

3.3.2 Context

Learning resource framework

In my MA research I studied learning in traditional rural crafts to develop a framework for the design of multimedia-based learning in

¹³ In this section I focus on learning resource development and a description of the related interactions with learners is provided in section 3.4.

skills with a substantial element of tacit knowledge (Wood 2003). This framework was used to structure the material gathered during the elicitation described in the previous section in order to test its veracity with the group of learners. Whilst this structure was not explicitly tested, the focus of this research being more on the content, implicit in the work was a test of the framework¹⁴. Its use in the practical work validated the structure, and the framework for understanding practical knowledge described in Chapter 5 provided further insight into its use. The only change I have felt it necessary to make is to alter the descriptive language to less emotive terms that do not have differing meanings in different disciplines as the original did.

The learning resource framework (see Figure 25) consists of three phases: introductory, guidance and development. The introductory phase provides an overview of what is to be done and introduces any key skills or strategies, the guidance phase guides the learner step-by-step through the process and explains any common errors and the development phase offers the learner the opportunity to evaluate the outcome, identify and solve problems, and encourages repetition.

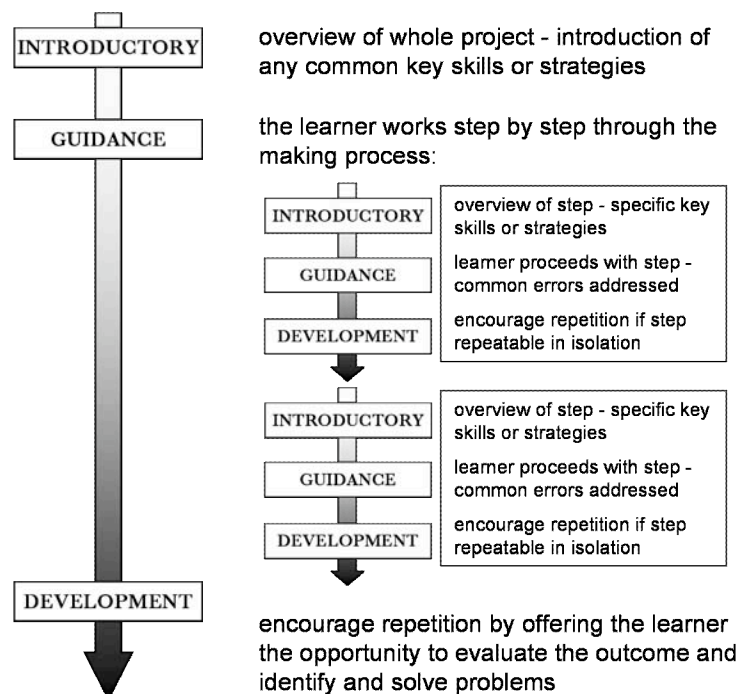


Figure 25: Overview of the learning resource structure.

¹⁴ Gedenryd (1998, p136) describes, "In experimentation the inquiring function is ... usually implicit, as part of an action that also has a productive function."

In the practical work section, below (p49) I shall describe how this was used to structure firstly the low-fidelity prototypes, and then the interactive learning resource.

Literature

The literature described here falls into two parts. The first half is a review of notation systems that have been developed to represent dynamic movement. These were considered as a means of representing the dynamic movement of the tool but rejected, as it is not helpful for the self-directed learner to learn to read a new notation system at the same time as learning the practical skill. As an alternative I consider the literature that covers more broadly the use of representation in multimedia learning resources and cognitive design principles to afford effective learning.

The earliest attempts at recording and analysing craft skill probably lie around a hundred years ago in the work of F W Taylor, father of scientific management, and the lesser-known work of Frank and Lillian Gilbreth. Whilst such approaches have been accused of reducing creative practices to a series of standard, unskilled tasks, they are of interest to the extent that they look at building a language to record and communicate movement. This theme is developed in the following overview of literature considering design considerations for the use of graphical representation in learning, in particular comparisons between the use of static and animated graphics.

F W Taylor devised a method of analysing and refining craft skills that he published in a book *The Principles of Scientific Management* (1911) and this led to many innovations in industrial engineering (Sandrone 1997). Around the same time (1908-1924) Frank and Lillian Gilbreth devised a system for recording the motions involved in performing a task, primarily to improve efficiency in brick-laying in the construction trade, but later used for wider applications (Ferguson 2000). Different actions were assigned different icons, known as "therbligs" (Figure 27) and these were used to record sequences of events undertaken by workers with a view to optimising and standardising procedures for all workers.

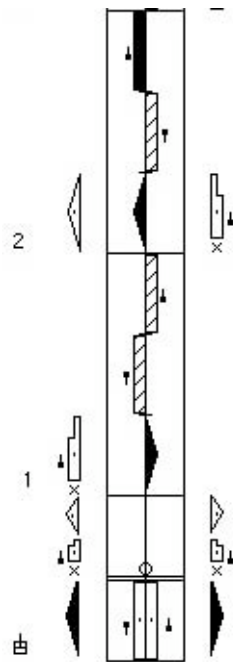


Figure 26 (left):
 Sample of
 Labanotation from a
 ballet score.

Figure 27 (right):
 Therblig chart
 showing mnemonic
 symbols and
 standard colours
 used for charting

Therblig	Color	Symbol/Icon	Therblig	Color	Symbol/Icon
Search	Black		Use	Purple	
Find	Gray		Disassemble	Violet, Light	
Select	Light Gray		Inspect	Burnt Orange	
Grasp	Lake Red		Pre-Position	Sky Blue	
*Hold	Gold Ochre		Release/Lead	Carmine Red	
Transport, Loaded	Green		Unavoidable Delay	Yellow Ochre	
Transport, Empty	Olive Green		Avoidable Delay	Lemon Yellow	
Position	Blue		Plan	Brown	
Assemble	Violet, Heavy		Rest for overcoming fatigue	Orange	

Whilst such analysis, particularly the use of time and motion studies, greatly improved productivity they have also been criticised for dehumanising the making process by reducing complex skills to a series of sub-tasks that can be preformed by relatively unskilled labourers (Sandrone 1997).

More recently, two prominent notation systems have been developed for use in dance. Labanotation is the most widely used in USA and comprises of a series of symbols, related to music notation, on a vertical body 'staff' (Figure 26). The symbols, written from the bottom upwards, depict the direction, the part of the body, the level and the length of time of the movement (Dance Notation Bureau 2005). Benesh movement notation is more widely used in the UK and is written on a traditional music staff with the staff lines coinciding with features of the body and movement lines describing the paths taken by the limbs (The Benesh Institute 2005). In addition, the Eshkol-Wachman movement notation system was originally developed for use recording dance, but has also been extensively used in research into both animal behaviour and neurological syndromes (Eshkol Wachman Movement Notation 2005).

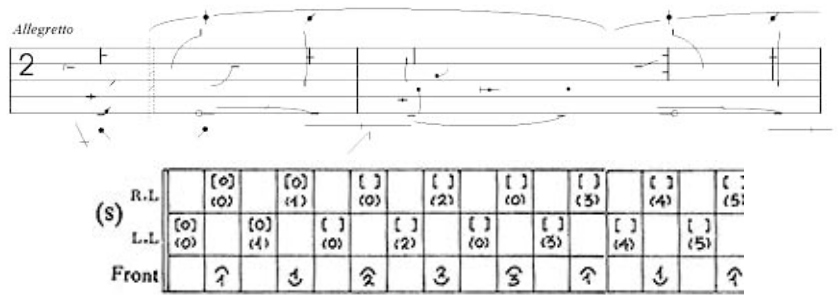


Figure 28: Benesh (top) and Eshkol Wachman (bottom) movement notation systems.

Loke *et al* (2005) discuss the potential drawback of such notation systems being that, whilst they can convey detailed information, learning to read them can take considerable time. Scaife and Rogers (1996) suggest this applies to a broader range of graphical notation methods: “a circuit diagram, an architectural plan or a mathematical notation comprise a set of meaningless symbols to the uninitiated; they only take on their meaning through learning the conventions associated with them.” The counter-argument to this is that once they *have* been learned, their use becomes tacit and a highly effective means of conveying complex information, however this pre-supposes ongoing use of the guidance provided by the notation system. My understanding of the craft learning context is that the interpretation will only be used in the ‘guidance’ phase of learning (see Figure 25, p44) whilst the novices learn the fundamental principles behind how the tools work. Thereafter their knowledge becomes personal and context-specific as they learn how *they* use the tools in specific circumstances so the choreography provided by the notation system would become redundant¹⁵.

A review of literature relating to the use of graphic representation in multimedia learning resources revealed some debate about the benefits of animated over static illustrations, with several widespread reviews concluding that there was little evidence to substantiate claims that animation was superior (Scaife & Rogers 1996, Narayanan & Hegarty 2002, Tversky *et al* 2002). This research considered the learning of knowledge that was largely explicit, for example how a toilet cistern works, so was not necessarily directly comparable to the craft knowledge studied in this research which is based on

¹⁵ The nature of craft knowledge is discussed in full in chapter 5.

demonstration by an expert, either recorded or live. However, there were indications that design principles could be used to make use of animation more effective.

Tversky *et al* (2002) suggested that animation often failed what they called the apprehension principle: that "the structure and content of the external representation should be readily and accurately perceived and comprehended." Animations were often too fast and too complex to be taken in and also, in response to this, what were actually continuous events were perceived as a sequence of discreet steps. They proposed that judicious use of interactivity, the ability to stop, start, review, and view from different perspectives, might overcome these problems and help realise the potential of animation.

Narayanan & Hegarty (2002) proposed a cognitive process theory for the comprehension of multimodal¹⁶ presentations and offered recommendations for 'cognitively designed' presentations. In their own test of these principles, comparing four resources: conventional static, cognitively designed static, conventional animated, cognitively designed animated, they concluded that the cognitively designed presentations were more effective than conventional presentations, but that there was no significant difference in learning outcomes between the animated (computer-based) version and the static (paper-based) one. Mayer & Moreno (2002) summarised these cognitive design principles as:

- multimedia principle: animation + narration rather than narration alone
- spatial contiguity principle: on-screen text near corresponding animation
- temporal contiguity principle: corresponding narration and animation simultaneously rather than successively
- coherence principle: exclude extraneous words, sounds, and video
- modality principle: animation + narration rather than animation + on-screen text

¹⁶ i.e. information presented in multiple modalities e.g. auditory and visual.

- redundancy principle: animation + narration rather than animation + narration + on-screen text
- personalisation principle: words in conversational rather than formal style

In a later test of these principles, Mayer (2003) concluded, "Using different technologies does not change the fundamental nature of how the human mind works; however, to the extent that instructional technologies are intelligently designed, they can serve as powerful aids to human cognition."

3.3.3 Practical work

In this section I describe the development of the learning resource through making and testing a series of simple, low-fidelity prototypes to verify the content before producing a computer-based interactive version. Whilst there was only time for limited testing within the timescale of this research, the early indications were that the structure of the resource and the content developed in this way would effectively support self-directed learners.

The prototype learning resources were based on the structure described above (Figure 25) and the content was focussed on the first two phases, overview and guidance, because the learners were at an early stage in the learning process and did not have the opportunity to develop their skills within the time span of this research. Edited video from the elicitation sessions was provided alongside the paper-based material and the learners proved keen to watch it. Whilst it provided them with an effective overview of tasks to be performed, they consistently struggled to use it to inform their learning and those learners who used the explicit interpretation appeared to gain a better grasp of key skills¹⁷. During the testing I experimented with several modes of representation for the interpretation, concluding that simple line drawings were most effective and could be easily generated and manipulated using a sketch-and-scan method.

¹⁷ this is further discussed in the 'Craft Knowledge' chapter, p99

3.3.3.1 Resource I

The first prototype learning resource (see appendix I, p163) was largely based on the focussed observation of regular practice and the subsequent semi-structured interview (see p39). The content used is summarised below:

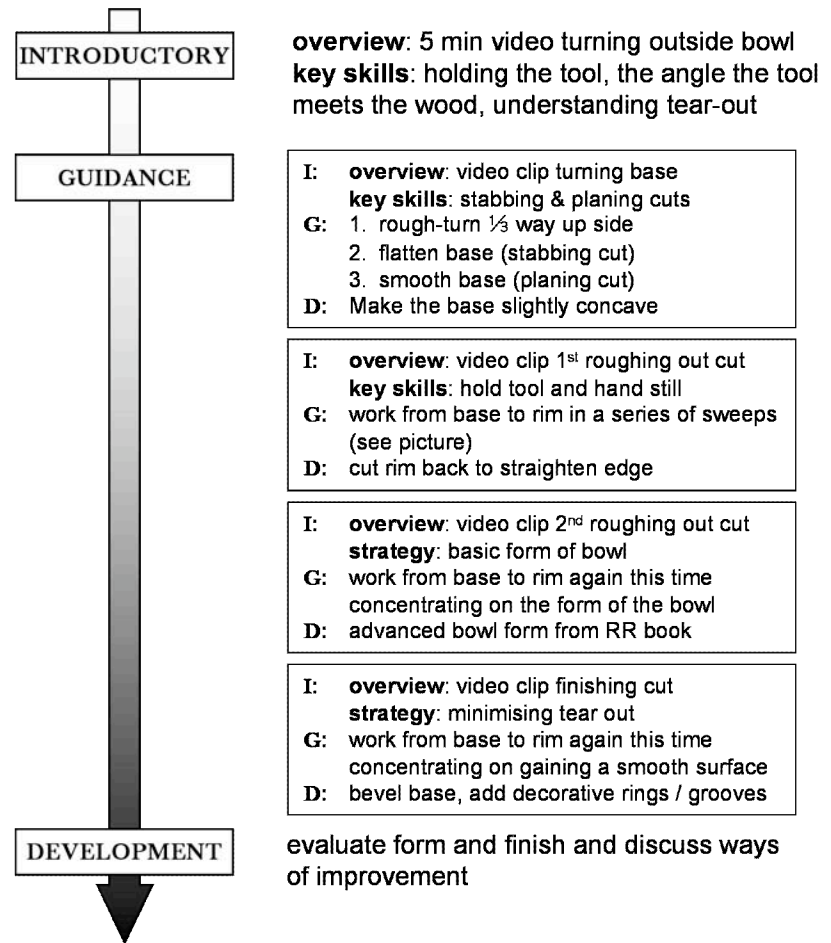


Figure 29: Summary of Resource I.

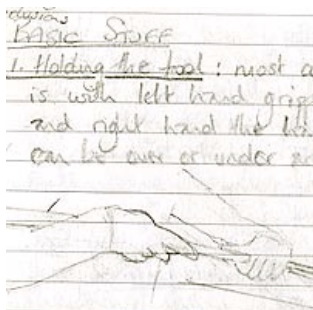


Figure 30: Sample from 'notebook' resource.

This prototype was very simply produced, consisting of several pages of hand-written text and sketches in my notebook that were deliberately presented in an informal manner to indicate to the learner that they were open to interpretation. I wished to make clear to the learner, Giles, that this representation was speculative; there were issues I did not fully understand and I wished to encourage him to explore and experiment. I had also identified some video taken during elicitation with the practitioner that I thought would be useful and made them available on a laptop computer so they could be viewed in the workshop.

The text and illustrations proved a useful starting point for establishing what was of importance to the learner but the use of the video was limited to providing an overview. The drawings of hand-holds on the tool provided a useful point for experimentation and the learner discovered that it was easier to keep the tool still when holding the tool in his fist as the expert could be seen doing, rather than trying to clamp it to the tool rest as he advocated (see Figure 22 & Figure 23, p40). It also rapidly became apparent that, at this stage of learning, the difference between roughing and finishing cuts was superfluous and the main issue for a learner was how to get the tool to cut at all. I had been unable to understand the practitioner's explanation of this theory and the learner proved unable to work it out in practice. To progress both my own and the learner's understanding of techniques, the practitioner was invited into the workshop to offer advice (see p63).

3.3.3.2 Resource II

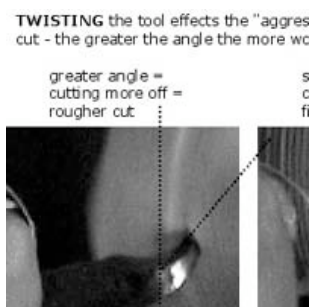


Figure 31: Annotated still from observational video.



Figure 32: Desktop links to video clips.

The next stage was to update the resource to reflect feedback from the learner and practitioner, moving from paper to digital production so further modifications were possible and it would be easy to produce several copies for working with more learners. Microsoft Word was chosen as a simple tool for handling the text and images (see appendix I, p166)

I selected and edited specific video clips as an overview to each stage and made them more accessible to the learners by providing icons on the computer desktop (Figure 32). The illustrations were made using annotated stills taken from the observational video that were quick and easy to generate by moving the video forward frame by frame until a clear shot was found then extracting the frame as a jpeg. I reduced the number of stages in the guided phase, feeling two roughing-out cuts were unnecessary and their inclusion made the process look more complex. These cuts were shown in three stages to demonstrate the movement of the tool as it progressed from base to rim.

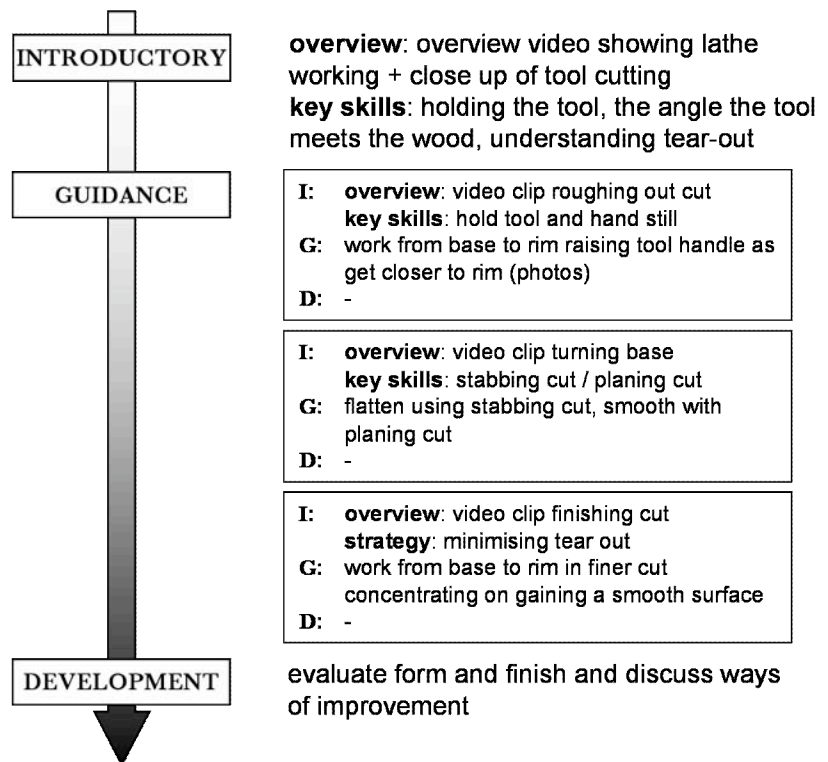


Figure 33: Summary of Resource II.

This resource was tested with two learners: Giles having his second attempt at the craft and Helen as a complete novice. Both learners found the stills taken from the videos difficult to relate to with the main difficulty encountered being the perspective: the images were taken from the observer's point of view and the learners struggled to relate this to what they were actually looking at:

21.30 HS: "Eek"

NW: "Problems?"

HS: "Yes"

NW: "Do you want me to help?"

HS: "Yes, it's the chisel going inwards again ... I think it's because I'm not holding it firmly... how does ... where are the pictures?"

NW gets the printed sheets showing how RW holds the tool. HS is looking at the one where he's holding the rest because that's what she's been doing. NW says he doesn't do that one so much on the outside and draws attention to the fist on the rest.

HS, screwing up face: "I can't quite work out how his thumb's ... oh, is it like that?"

NW: "His thumb's kind of up there isn't it, so maybe his thumb is back here I think?"

HS, moving her grip: "It's on this side ... but it's back to front, isn't it?" She then manages to get the grip.

NW: "Yes, like that so then you're not actually holding the

tool rest but this [points to fist] should act as a stop some how."

HS starts turning.

Helen interview 26.3.04 [event log HS1 t21.30]

I considered taking revised photographs or video from the practitioner's point of view, but felt this would be both intrusive on the practitioner and time consuming to capture the shots needed. However, during informal conversation after the session, Giles had expressed a preference for the line drawings that had been used to illustrate the previous prototype resource, feeling they provided clarity by getting rid of extraneous detail. I felt that by sketching rather than using photographs, the illustrations could emphasise the interpretive nature of what was being displayed as well as being able to show the learner's perspective without intrusive photography¹⁸.

Following discussion with a fellow research student whose main medium was drawing cartoons, I developed a technique that became both rapid and adaptable. The individual elements needed for each illustration were hand drawn on paper, scanned and manipulated in Adobe Photoshop to make transparencies, and then complete images were built up using multiple layers. The fixed portions were printed out, movable elements redrawn and then rescanned to generate the sketches needed. These layered images had the additional benefit that they could be used to create animations in the interactive version.

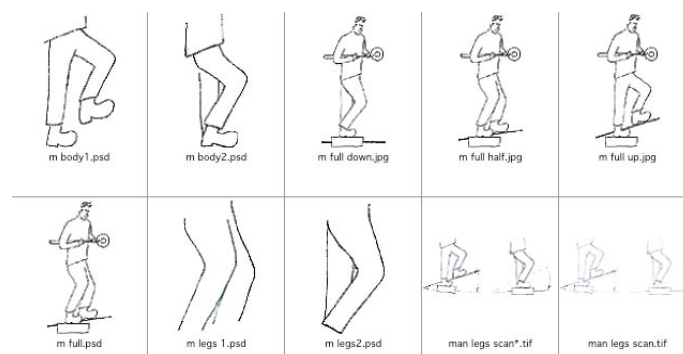


Figure 34: Line drawings generated to demonstrate treading action.

¹⁸ In a study of the use of sketching in the design process Tversky (1999) says, "drawings differ from images in that they reflect conceptions, not perceptions, of reality."

3.3.3.3 Resource III

A final paper-based prototype was then produced with the aim of focussing the learners' attention on adopting the correct body stance and understanding how different movements of the tool affected the cut (see appendix I, p171). The content was structured as follows:

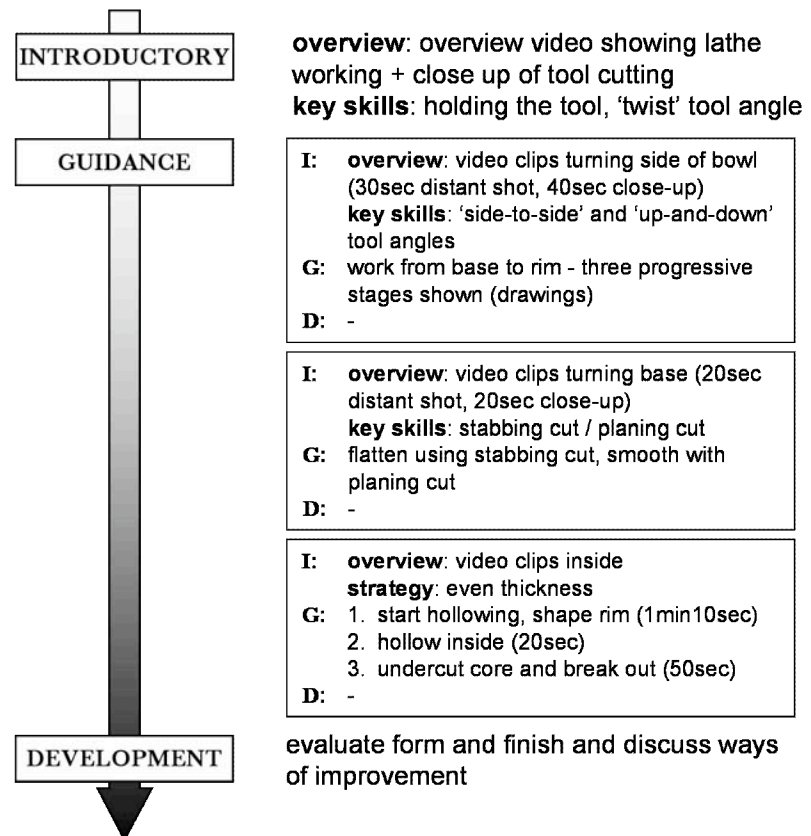


Figure 35: Structure of resource III

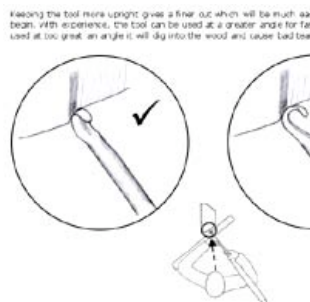


Figure 36: Sample from resource III.

What had been separate photos showing different hand grips on the tool were simplified to show the grip which it was now established Robin used most of the time (Figure 23, p40) with a variation of the handle being either underneath or on top of the arm. The drawings showed two perspectives, one a view from above, and the other from the learner's point of view, to help learners relate the drawings to their own body.

The 'twist' movement was shown using close-up drawings of a tool as it met the bowl, showing what was right and wrong from the learner's perspective (see Figure 36). The side-to-side movement and up-and-down movement were shown on a separate sheet in three stages moving from base to rim, again pictured both from above and from the

observer's perspective.

The differentiation between roughing and finishing cuts was removed because, at this stage, the aim of the learner was just to get the tool to cut. A third stage was now added, providing a series of videos showing in three stages how the inside of the bowl was hollowed. These videos had voice-overs achieved by dubbing the practitioner's description from the 'concurrent verbalisation' session (see p37) over the observational video.

This resource was only effectively tested with Helen returning for her second attempt, because the other learner, Mick, declined to use the interpretation, preferring to attempt to learn by experience or through watching video¹⁹. However, Helen's response was sufficiently positive to give me confidence in the interpretive drawings and to feel that the resource content would be unlikely to need major revision in broader testing, so it could be used to construct a computer-based interactive version.

3.3.3.4 Resource IV

Initially I developed a layout in Microsoft PowerPoint (see appendix I, p173) before creating the resource in Macromedia Director. Whilst I find Director a useful tool for creating interactive resources without needing much knowledge of computer programming languages, I find once the initial content is laid out making changes can be exceedingly complex. Even the simplest of screens usually contains many overlapping elements and alterations to one part can easily have a much wider impact than planned. For this reason, the graphics and text used in the Word version of the resource were firstly imported into PowerPoint to allow the initial screens to be laid out and a standard structure to be developed that would easily expand to fit more content. This PowerPoint version was retained as a development tool in which new ideas could be sketched out in a 'safe' environment before

¹⁹ A the end of the session, however, he looked through the material and expressed a wish to make another bowl at a later date using the learning resource. When he did return it was about a year later and arranged directly with Robin who reported that Mick seemed disappointed that the learning materials were not available at that time.

deciding whether to implement changes in Director.

The basic content remained the same as resource III but now included plans for content to be added at the development level:

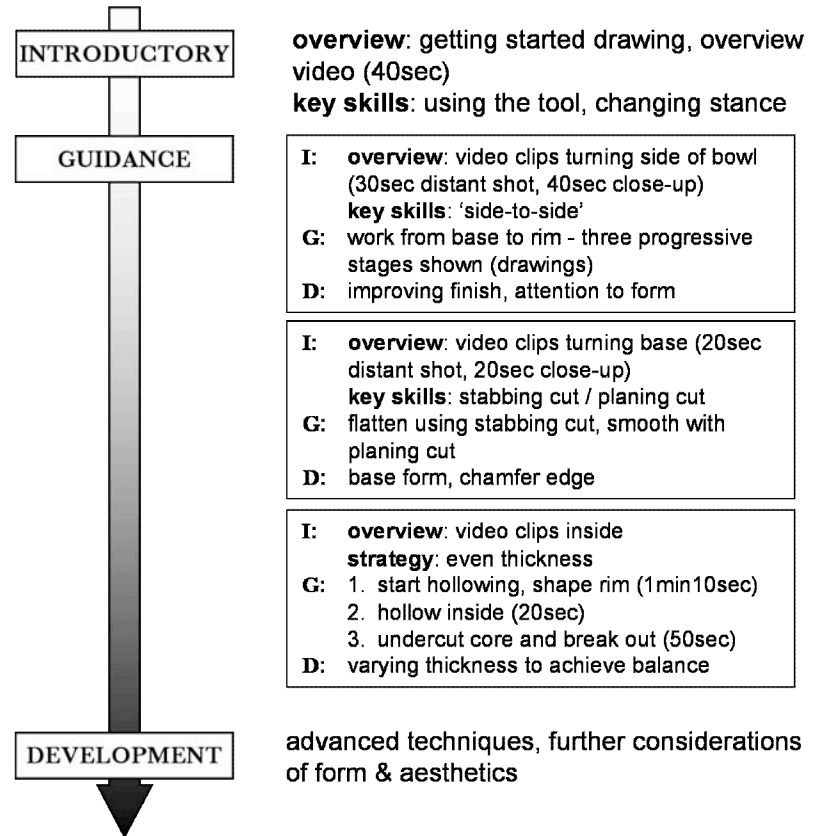


Figure 37: Structure of resource IV

The phases were represented by card-index style tabs with, at a macro level, the overview phase provided by the introduction section, the guidance phase by the step by step and problem solving sections, and the development phase by the advanced section:

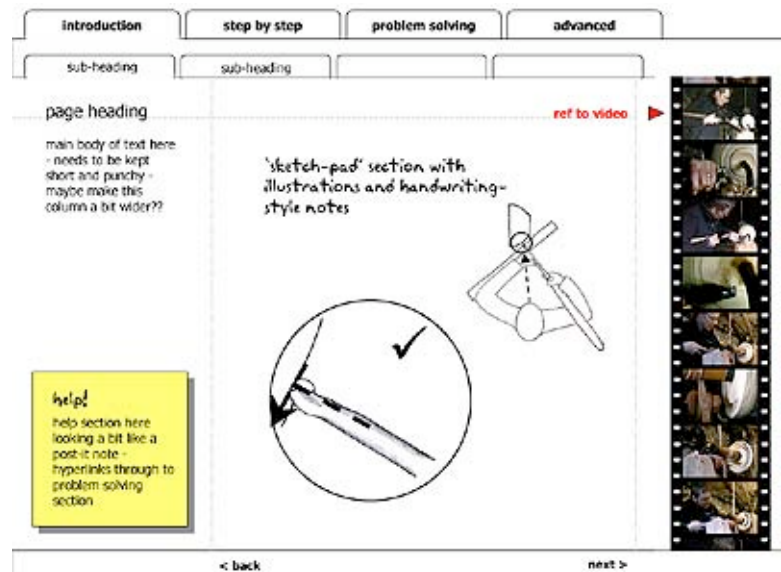


Figure 38: Screen layout developed in PowerPoint.

Each of these phases could be sub-divided into further sections represented by another layer of card-index style tabs. The 'cards' themselves were divided into three zones, with the first containing the overview in the form of a short section of descriptive text. The central column provided the main guidance, with hand drawn illustrations and notes in a handwritten-style font, supported by a help section to the left showing common errors, made to look like a post-it note to lift it from the rest of the text. The column on the right provided links to relevant video clips, represented by a graphic that looked like a length of celluloid film. It was anticipated the learners would be keen to view the video, although initially they would be unable to interpret so it would just provide them with an overview. As their skill advanced they would gain more from watching it, seeking their own interpretation and experimenting with techniques.

The computer-based version was tested with just one new learner, Andy as an exercise in resolving practical design issues raised by this research. Although it is not part of the purpose of this PhD project to evaluate the designed 'product', its use²⁰ did support the product development process running parallel to the research. Outside the scope of this project, I plan to complete the resource and gain broader feedback on it as the practitioner has now started teaching some short courses and he would like to make the resource available to the

²⁰ as described in section 3.4.3.4, p72

learners to support their subsequent self-directed learning.

3.3.4 Discussion

The prototype learning resource based on the previously developed structure provided an effective means for representing and evaluating craft knowledge. Whilst I could claim some benefit from application of cognitive design principles, what they essentially suggested: "adding pictures to words, eliminating extraneous words and pictures, placing words near corresponding pictures, and using conversational style for words" (Mayer 2003) proved to be largely a common-sense part of the design process for me.

Of more interest was the use of commentaries, which I only introduced half way through by using the practitioner's voice from the elicitation sessions dubbed over some footage of him turning the inside of a bowl. Whilst the learners struggled to interpret the video themselves, the narrative appeared to have made a more lasting impression as they had a tendency to reference to the words they had heard when working subsequently. In future research I plan to experiment further with using commentaries both with static illustrations and with animations / video.

This observed difficulty the learners encountered using video to teach themselves appeared to uphold the literature into the failure of animation (Scaife and Rogers 1996, Narayanan and Hegarty 2002, Tversky *et al* 2002). As well as encountering difficulties interpreting what they were seeing, they seemed to find it difficult to transfer what they had seen to their own actions. This is discussed further in the 'Craft Knowledge' chapter where I review the learners' experiences in the light of further theory.

3.4 Application

3.4.1 Introduction

In this section I describe how theory was advanced through engagement with learners applying craft knowledge. This process involved a small group of novice practitioners who used the developing prototype resource (described in section 3.3) to support their learning of the craft skill. Whilst describing this separately creates some repetition over the previous chapter which dealt with development of the content of the learning resource, it enables the events to be viewed again specifically from the perspective of how the use of the learning resource informed both its content and supported the theory development described in chapter 5.

I provide the context for this section in the literature relating to use of rapid prototyping techniques, highlighting the different purposes such artefacts can have for exploring the general context of use and experimenting with specific functions. I relate the practical work undertaken describing use of paper-based prototype resources primarily for exploratory purposes and a computer-based interactive resource primarily for experimental purposes. I conclude by considering my role in the research showing how, rather than being a passive computer-operator, I adopted the more involved role of designer-researcher.

3.4.2 Context

Rapid prototyping techniques have become widely used in a range of design practices. Gedenryd (1998 p149) proposed that the artefacts created during prototyping might have more than just a productive purpose, they could also have a second, inquiring purpose: they could be the "means for the inquiry that design is". He made a further divide between experimental and exploratory artefacts, with the former "being concerned with detailed tests - experiments - with the design itself and its internal workings" (ibid p172) and the latter "spanning a

wide range of possibilities without heading in any specific direction or searching for a specific goal" (ibid p152).

Gedenryd suggested an exploratory purpose for what Rettig (1994) described as 'lo-fi' prototypes: produced using hand drawn graphics reproduced on a photocopier, post-it notes, acetates, index cards and so on. Such prototypes could be made rapidly and informal tests carried out frequently with anybody available to quickly develop and evolve ideas. Rettig advocated use of this approach over 'hi-fi' prototypes that would lead to testers tending to comment on 'fit and finish' issues, like the colour scheme or typography, at a stage when the focus needed to be on the bigger picture. These more sophisticated prototypes also took too long to build and alter and, because of this, developers tended to resist changes. Diaper (1989) observed that this often led to the application of 'elastoplast solutions' to the latest issue rather than a reassessment of the overall system to consider whether there was a more efficient method of proceeding. The result could be that the prototyping never ended and the system delivered was merely the final prototype.

Ehn & Kyng (1991) highlighted a different dimension to the paper prototyping concept with their description of 'cardboard computers', mock-ups that encouraged journalists and typographers in newspaper production to role-play using a computer-supported system. Their mock-ups were deliberately unsophisticated: a cardboard box with 'desktop laser printer' written on the side, a matchbox as a mouse, and a sheet of paper as a display. This, they felt, encouraged a 'hands-on' approach, providing an environment which empowered all participants to use and modify the prototype without constraint. Gedenryd (1998 p176) referred to this as a 'situating strategy', a means of contextualising the artefact and enabling the designer to draw inference from its use.

3.4.3 Practical work

In the practical work undertaken with the bowl turners, the first three prototypes²¹ were primarily used for what Gedenryd referred to as an

²¹ Resources I, II and III, see Appendix I.

exploratory purpose. Whilst the final aim was to produce an interactive learning resource, these prototypes were not mock-ups of that resource; there were no pretend screens, pictures of buttons or imaginary links to other pages. Instead they were used to explore the context and gain insight into the situation of a self-directed learner in the workshop. However, some of the *content* within the prototypes could be seen as experimental in Gedenryd's terms, in particular the drawings and video clips used as illustration, and the final interactive resource [IV] also fulfilled this purpose.

The descriptions of the sessions with the learners below show evidence of the developing dual designer-researcher role. Whilst on each occasion I anticipated leaving the learners to direct their own learning and for my role to be 'computer-operator' to provide learning materials, once the sessions were underway other interventions were frequently deemed appropriate. At times this just involved steering the learner towards material I thought would help although at other times, when neither the learning resource nor myself could provide assistance, the practitioner was invited into the workshop to teach.

3.4.3.1 Resource I

Overview



Figure 39: Giles and myself in the workshop.

This was primarily an exploratory session with my main aim being to explore the context of a self-directed novice learning the craft skill. The resource was very 'lo-fi' consisting merely of some notes and drawings in my notebook along with some unedited video of the practitioner working at normal production speed²². I was aware that some of the interpretation I had was incomplete and aware of differences between the practitioner's recommendations and the practice I had observed.

Working collaboratively with a novice learner, Giles, this was used to both test my understanding and my representation of the knowledge elicited. Once we had pursued this as far as my understanding could take us, the craft practitioner worked with the learner to try to teach him directly. Whilst this was not entirely successful, the act of explaining

²² The content is discussed in the Representation section on p50.

again the principles behind the use of the tools clarified them in his mind and he then initiated a very focussed concurrent verbalisation session in explanation.

It also uncovered a difference between the practitioner's espoused theory and his theory-in-use (Argyris 2003): where his declared method of working was at variance to that observed. The practitioner's response to this was initially complete denial until he had reviewed the observational video which produced a reluctant acceptance. Dealing with this sensitive situation in this manner was made possible by working with close acquaintances, but it led to consideration of more generalisable methods suitable for designers working with practitioners who they do not have a close relationship with which is discussed in the 'Craft Knowledge' chapter (p99).

First learner (Resource I: GB1)

Giles firstly watched the video of Robin turning, and then we discussed the key skills using a turning tool and a bowl that Robin had previously turned as props. I was open about the limitations of my knowledge and, in particular, I explained the differences I had perceived between Robin's recommended way of holding the tool and his observed way and suggested to Giles that he experiment in an attempt to throw some light on the differences.

In the workshop Robin had previously mounted a blank on the lathe, selected and sharpened two tools for the learner. Before starting turning, Giles expressed an initial concern about how fast he should treadle and reviewed the first video again until he ascertained that the speed varied and he could turn at any pace he felt comfortable with. For about an hour he experimented in his own way, whilst I stimulated discussion to gain some feedback on what he was trying to achieve and what his understanding of the outcome was. At times I attempted to steer him towards experimenting with some techniques I felt might be helpful and also tried to generate a dialogue about them and to gain some insight into their effectiveness. His major difficulty was finding a position in which he could depress the treadle with sufficient power, hold the tool rigidly and hold it at an angle which would achieve

a good cut, all at the same time.

Whilst this in its own right did not lead to an understanding of the points in question, it allowed both the learner and myself to get a feel for the difficulties of the task and what he needed to learn before having the practitioner explain it directly. In the learner's own words:

37.26 NW: *Would you find it intimidating to be doing that in front of [Robin], having him watching you do it badly?*

GB: *To an extent, yes. I think it would actually speed up my learning process, but for that first few times doing something it's actually quite nice to do it and begin to get a feel for it. Whereas if he'd come straight away when I'd first started on it, I'd have been ... stopping and starting more because he'd have been saying, "Well I think you should do this" or, "You've got that the wrong way round."*

Giles interview 5.2.04 [event log GB1]

By this stage we felt we had reached the limitations of the resource so continued by involving the practitioner, firstly with some direct teaching and then with some further elicitation.

Working with the craft practitioner



Figure 40: Practitioner adjusting the learner's tool angle.

Robin's initial focus was on the problematic issue of the angle at which the tool meets the wood, trying to explain directly to the learner the way in which different movements affect the cut. Giles struggled to understand the explanation, confused by Robin's use of "tipping up" to describe twisting the tool and Robin frequently had to move the tool in Giles' hand into the correct position himself.

Next Robin stopped Giles and gave a detailed explanation of how to hold the tool on the tool rest, clamping it with the hand and using the hand as a pivot (Figure 22). It was notable at this point that Robin was unable to explain his theory without a tool in his hand and shortly into his explanation went to fetch one from the tool rack, using the other end of the tool rest to demonstrate the handgrip.

Whilst struggling with keeping the tool still, Giles had experimented with different handgrips, but by this stage had adopted the hold Robin was most frequently observed using (Figure 23) as it kept the tool much more firmly in place, rather than the handgrip Robin was

promoting. When I explained this to Robin, he was exceedingly surprised and could only be persuaded there was some truth in it by watching some of the video on the laptop computer. Even then it was not until he actually stood at the lathe, spinning Giles' bowl and experimenting with holding a tool in different ways that he finally conceded, "Well, there you go, I never knew that!" [event log GB1 t0.48].

Giles then proceeded to finish turning the outside of the bowl under the supervision of Robin, during which time Robin frequently intervened to correct Giles. Whilst the finish of the bowl was considerably better than previously, Giles continued to find it difficult to solve problems on his own as Robin had a tendency to correct him before he was aware he had a problem.

I had originally planned for this to be the end of the session, but Giles was keen to finish his bowl by turning the inside too. As I had not assembled teaching materials for this part of the process, Robin mounted another bowl blank on the lathe to demonstrate instead. He rapidly turned the outside of the bowl without explanation, other than commenting shortly after starting, "I do hold the tool like that, don't I" in reference to the discussion we had previously held about handgrips [event log GB1 t1.09].

Robin then hollowed the inside of the bowl whilst explaining to Giles what he was doing. Subsequently comparing this to the video taken during the previous concurrent verbalisation session (see p37) his explanations were now more focussed on tools and techniques and less on the form of the bowl, showing a shift towards understanding the needs of the novice. He then decided it would be best to leave Giles to experiment for a while on his own, so left the workshop saying, "Not much more I can say. It's not easy, I'll be impressed if you can get that far".

Once Robin had left the workshop both Giles and myself found it difficult to remember what we had been told. Giles managed to hollow a reasonable way into the bowl, but was constantly fighting to get the tool to cut well and was uncertain if this was because he had the wrong tool, the wrong angle, or was just not holding the tool firmly

enough.



Figure 41: Giles with his nearly finished bowl.

When Robin returned to the workshop he was impressed with the progress Giles had made. When he observed Giles turning he felt the problem was again the rotation of the tool making it cut too aggressively and helped him to change it to get a better cut. He then had another go at explaining his concept of the angle at which the tool should meet the wood, still struggling for words, but this time demonstrating what 0° and 90° are first before showing where the 10° angle was that he should be using.

This time Giles seemed to have gained a better grasp of the concept and managed to skim the inside of the bowl without digging in and was able to concentrate on getting a smoother surface. Robin then helped him to complete the bowl by removing the core with a chisel and Giles seemed very pleased with the result.

Further elicitation with the practitioner

At the end of the session with Giles, Robin said that having explained how to get the tool to cut correctly several times both to myself and a learner, he felt he had worked out a way of explaining it succinctly and offered the opportunity to film this explanation in the workshop.

He did this by dividing the movement of the tool into three: up-and-down, side-to-side and twisting:

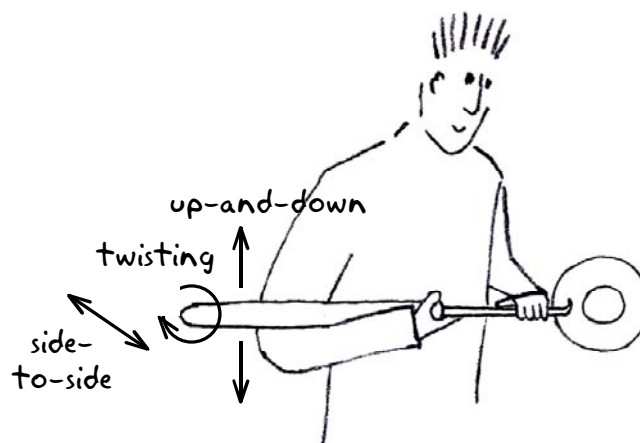


Figure 42: The three movements of the tool.

He described and demonstrated the different effect of each movement: side-to-side affected the shape of the bowl and twisting affected the aggressiveness of the cut. Robin was uncertain about the precise affect of the up-and-down movement, but he felt that normally he held the

tool level, only lifting it up to achieve a fine cut close to the rim.
Review of the focussed observation videos confirmed this.

Whilst Robin's narrative as he explained the different actions of the tool was hesitant, with him struggling to find meaningful words, it was sufficient for me to feel I had gained a basic understanding which I had not been able to previously. I also was able to film some close-up footage of the tool cutting to illustrate the results of different actions in the resource.

3.4.3.2 Resource II

Overview

The prototype resource had now taken on a more formal aspect, being produced in Microsoft Word, illustrated with stills from the video, and including shorter, edited video clips to illustrate specific points²³. I now felt I had an understanding of the key skills the learners needed, so wished to stand back more in these sessions to see if the learners could gain an understanding using my interpretation.

In the first test of this resource however the returning learner, Giles [GB2], was not keen to use the interpretation at all, preferring to try to use the video, which he struggled to interpret, or to experiment on his own. Seeing him struggling, I intervened several times to encourage him to look at the interpretive sheets, but he was not keen. He eventually gave up, exhausted, and did not attempt to hollow inside the bowl.

The second test involved a new learner, Helen [HS1], who was keener to look for help. Although her questions were mostly aimed at myself, I was able to act as 'computer operator' providing her with information from the resource whenever possible. However, I also soon became aware of the shortcomings of the material and that if completely left to her own devices she too would be likely to rapidly exhaust herself and become disillusioned, so periodically intervened to offer suggestions.

²³ An overview of the content is in the Representation section on p52.

First, returning learner (Resource II: GB2)

Approximately six weeks after his first trial, Giles returned to make another bowl and test the new learning materials [GB2]. He was enthusiastic about having another attempt, feeling he had established the principles on the first time and was confident that he could progress with little assistance. On his arrival we started by briefly looking through the sheets and discussing his major problem in the previous session, achieving the correct cutting angle of the tool. We watched a little of the video together and I showed him how to access what was there from icons on the desktop.

After a first tentative attempt at turning and suffering a series of dig-ins he returned to watch the video briefly, had another unsuccessful go on the lathe, then returned to the video again, claiming he was holding his tool at the same angle as Robin in the video. At this stage and again several times later I intervened in an attempt to assist Giles, feeling that his interpretation was different to that which I had intended. He was resistant to most suggestions from myself, seeming to prefer to learn by his own experience, so I otherwise left him to experiment on his own. As related in the 'Representation' section, discussing this with him afterwards, he did not give a specific reason for this, but commented that he had preferred the drawings in my note book [Resource I] to the stills from the video that contained too much extraneous detail.

Working on his own, Giles eventually appeared to get to grips with the twisting movement to avoid dig-ins but not the side-to-side movement necessary to shape the bowl (see Figure 42, p65). As a result the surface of the bowl he made was a series of large steps that he kept re-working until the sides became concave and he finally gave up after about an hour and a half, without attempting to hollow inside.

Second, new learner (Resource II: HS1)

Two days later I tested the same learning materials with a new learner, Helen [HS1]. Throughout the session she was much more keen to seek outside help than Giles, although frequently aimed

questions at me rather than looking at the materials provided.

Whenever possible, I referred Helen directly to a relevant drawing or video clip and if she had difficulty interpreting what she was seeing, I assisted with interpretation. As previously discussed, she too had difficulty with the stills from the video, largely due to difficulty in relating their perspective from that of the observer to her view of her own body. Also, in the light of Giles becoming exhausted and disillusioned when left unaided, I occasionally decided to intervene to encourage use of the resource or adaptation of technique to help her maintain momentum.

After around one and three quarter hours, Helen had made a reasonable attempt at turning the outside of the bowl, but was tired and decided not to continue with hollowing inside.

Review with practitioner

Whilst Giles was turning, Robin had commented he felt the major problem was an inefficient use of energy: taking short, stabbing pushes at the treadle rather than maximising the cut by pushing it from its highest to its lowest point. Robin turns with his left foot raised on a block of wood so the treadle can easily rise to its highest point and on the down-stroke he bends his left knee to push the treadle completely to the floor.

Half way through that session Robin had tried to improve Giles' stance by raising the block on which he was standing, but the block was small and had a tendency to wobble on the wood shavings on the floor so it did not help significantly.

Reviewing Helen's video with Robin, he identified the same problem and felt a major contributory factor was the height of both learners (Giles 5'4½" and Helen 5'4") being considerably shorter than his own 5'10". In addition, because they were experimenting with where to stand to achieve a good cut, the block was frequently in the wrong place for them. Before they returned he offered to find a larger block to overcome these problems.



Figure 43: Height difference between practitioner (top) and learner (bottom).

3.4.3.3 Resource III

Overview

This prototype resource was similar in format to the previous one but the sheets were illustrated with line drawings which helped the learners view them from their own perspective and were focussed upon encouraging the learner to adopt the correct body stance and understand how the movement of the tool affected its cut²⁴. In addition, Robin had replaced the block he stood on with one which was far larger and more stable, and provided a second large block to raise smaller learners to a height closer to his own.

The new learner recruited to help test this resource, Mick [MK1] declined any assistance other than watching a little video when hollowing the inside of his bowl. Whilst at the time this was frustrating, it ultimately provided useful input to the research, which is discussed in the Craft Knowledge chapter. The result was that this prototype was only tested with Helen [HS2], the returning learner and again, whilst my aim had been to intrude as little as possible other than being 'computer operator', weaknesses in it led me to intervene. This time it was my phraseology rather than the drawings that led the learner to misinterpret the representation.

Second, returning learner (Resource III: HS2)

Approximately three months after her previous attempt Helen returned to make another bowl. From initial discussions she seemed to have a good recall of what she had learned during the previous session so we went directly to the workshop.

Her initial reaction to the printed material with the photos replaced by drawings was positive and throughout the session there were no further problems observed with the way in which she related the drawings to her own body. More of a problem was her understanding of the language I had used in my labelling, thinking they implied she should move the tool sideways on the down-stroke of the tool rather than gradually as she cut around the bowl. This resulted in the outside surface of her bowl initially becoming far from round, a problem that

²⁴ An overview of the content is in the Representation section on p54.

she was unable to correct on this occasion.

During the session Helen demonstrated she had learned the 'twist' movement, obviously stopping, thinking, twisting the tool and making a comment about it. However, as with Giles during his second attempt, she still failed to understand how to find the correct sideways movement and ended up with large steps in the side of her bowl that she could not remove.

This time Helen progressed to hollowing inside the bowl using the video provided but struggled to find the correct angle to cut cleanly inside, a problem compounded by being physically small, at the limit of her strength, and being quite worn out from having spent two hours turning. Finally, Robin came into the workshop to help her complete her bowl, which she did but was too tired to make much improvement to her technique.

Third learner (Resource III: MK1)

Mick was happy to be filmed but initially did not want to look at any of the learning resource material, wishing to just experiment on his own. He is a similar height to Robin and turning the outside of the bowl was able to adopt a good stance and maintain a firm, regular treading action. However, he consistently failed to get the tool to cut properly, scraping off thin shavings rather than cleanly cutting the surface of the wood.



Figure 44: Treadle lathe.

This was caused by the side-to-side angle of the tool (see Figure 42, p65) being consistently at around 90° to the ideal position. Mick's previous experience was on a treadle lathe using a turning gouge, which affectively has the cutting edge at 90° to the cutting edge on a hook tool (see Figure 45). As he was self-taught it seems reasonable to deduce he had learned what angles worked with the gouge without understanding why, so could not work out how to make the hook tool work.



Figure 45: Relative cutting angles of hook tool (left) and gouge (right).

When it came to turning inside the bowl, the difference between his prior knowledge and the task at hand were more apparent. When hollowing inside the bowl on a treadle lathe, it is attached just by its base enabling the turner to completely turn away the wood inside. On a pole lathe the bowl runs between centres, so inside the bowl the turner has to cut a channel around a central core which is snapped out at the end of the process.

Mick started the hollowing process successfully, but soon struggled to deepen the channel and finally asked if he could see some video. We watched the video taken during the one of the first elicitation sessions where Robin talked about what he was doing as he turned the inside of a bowl. Mick watched very closely and intently, commenting that what Robin was doing was very different, specifically mentioning that he was using a different angle.

Mick continued to hollow the bowl, regularly changing the angle at which he was holding the tool and trying different tools, but never reliably achieving a good cut. Shortly before finishing he commented that he still had no idea what angle to use the tool at. Through persistence he managed to hollow sufficiently far down, undercut the core and snap it out to finish the bowl.

As we were packing up he commented that he felt he should have watched more video and he would like to come back and have another go, next time using the learning resource.

3.4.3.4 Resource IV

Overview

Having established the basic content and structure, I performed a final test of the material with a computer-based version of the learning resource produced in Macromedia Director²⁵. Whilst the main purpose of this was to resolve the practical design issues raised by the research, it additionally provided a preliminary test of the designed 'product'.



Figure 46: Andy using the interactive resource.

A new learner, Andy [AB1], was recruited to provide a completely fresh perspective uncomplicated by issues that had arisen in previous tests. Andy used it successfully when turning the outside of the bowl and at this stage I was largely able to just stand by and observe. He encountered more difficulty when turning the inside, for which there was no explicit interpretation, just a series of video clips. At this stage we worked together trying to understand the video but without success and, as with Giles' first attempt, we progressed by inviting the practitioner into the workshop to teach directly. He then successfully turned a further two bowls unaided.

Forth learner (Resource IV: AB1)

Andy also had some experience of using normal turning gouges but, unlike Mick (see p71), was able to adapt his technique and successfully turned three bowls during the course of an afternoon.

Turning the first one, Andy made extensive use of the learning resource, using the illustrations to understand how to achieve the correct tool angles. Although he frequently commented on how weird it was in comparison to the turning he had previously done, he appeared to gain a good understanding of how to use the tools on the outside of the bowl. He initially encountered more difficulty using them inside the bowl where no explicit interpretation was supplied, just video and Robin's commentary. On his own he was unable to interpret the video, although he persisted for some time, and we called Robin into the

²⁵ An overview of the content is provided in the Representation section, p56.

workshop to assist. Robin suggested he changed tool, although he would not offer an explanation as to why, and altered the place on the bowl where the tool was cutting to below the centre. Whilst Andy seemed uncertain whether he was achieving a better cut, Robin was very complimentary about his technique. Andy then successfully completed the bowl on his own.

Andy turned two more bowls without further reference to the learning resource. With both he achieved a good, clean cut on the outside of the bowl but continued to struggle when hollowing inside. The final bowl showed a marked deterioration in quality over the previous two, this I felt was probably due to Andy becoming over-tired.

Further development of resource

After working with Andy I felt that to complete the resource it needed the blank areas filling in and some minor modifications. For example, drawings needed producing for turning the base and hollowing inside the bowl. Some of the existing drawings that worked on an A4 sheet could be simplified for screen use using simple animation, but the originals could be retained for use by learners who did not have access to a computer in the workshop. The existing video could be put into an archive in the 'advanced' section and new, high-quality video taken to illustrate the 'guided' section. This would then have made it ready for more rigorous testing with a wider group of learners, but I felt this work would not have added to my research outcomes so I temporarily shelved the project.

Now I have the theoretical understanding of craft knowledge gained through the subsequent research that is described in the rest of this thesis, I feel it would be valuable to complete the project. Robin has recently started teaching some short courses and, given time, I hope to complete the interpretation and make it available to such learners to support their subsequent self-directed learning.

3.4.4 Discussion

The learning resource took several forms, progressing from a 'lo-fi' prototype, whose primary aim was exploratory, to a 'hi-fi' prototype,

whose primary aim was experimental. This enabled me to gain an understanding of both the context and the content of the learning material as I developed the interpretation.

My initial aim when working with the prototype had been to be 'computer operator' in the learning sessions, observing the learner using the resource and, if called upon to do so, providing them with material they could not find for themselves. As discussed in the Methodology Chapter (p16), I had deliberately not learned the skill so the novices would not perceive me as a teacher. The actual role played by myself was more complex than teacher or computer operator: it was the intuitive role of designer-researcher.

Firstly, rather than operating the resource, I was an integral part of it. When the learners asked for assistance I took one of several options. I could select some interpretation to show them and observe their reaction. If this did not help I could look for an alternative or, if it was just that they had difficulty understanding what they were shown, I could add a further explanation. If I did not have what they needed, I could consider if I knew something that I had not yet added to the interpretation that might help and test this out on them.

Secondly, the situation was not entirely driven by the learner. Having observed one learner [GB2] become exhausted and demoralised when left on his own, at times I felt the need to intervene judiciously to steer the learner towards help. The final source of assistance if all else failed was the craft practitioner himself. When he was called upon during the sessions, observing the guidance he gave to learners gave a further source of interpretive material.

3.5 Conclusion

In this first piece of practical work I sought to explore and interpret the practical knowledge of craft practitioner Robin Wood through the development and testing of a prototype learning resource. Initially I adopted a systems-based approach, framing the problem in terms of the three fields of knowledge elicitation, representation and application which provided a starting point for contextual review and preliminary work. However, increasingly the boundaries became less clear as I adapted to unfolding events.

The knowledge uncovered during the formal knowledge elicitation (stimulated recall / concurrent observation) was mostly more advanced than a novice would require and my attempts at getting the practitioner to discuss more fundamental issues were either rebuffed or treated defensively. The combination of focussed observation and semi-structured interview provided a useful starting point to enable engagement with a novice, although the novice proved unable to interpret the video unaided and my initial interventions were also unsuccessful.

Bringing the practitioner into the workshop to teach the learner directly proved to be a more productive frame experiment. It provided the practitioner with experience of explaining his theory to somebody who was trying to apply it and helped him develop an explanation of how to use the turning tools. It also revealed to him a difference between his espoused theory and theory in use regarding how to hold the tool, although he was reluctant to accept it until he resumed his normal practice.

Through further refinement and testing of this material with a small group of novices I developed a prototype resource to support their learning, building on the principles I established through my MA research. Through careful management of the recording process I was able to immerse myself in the sessions with learners in the knowledge that I would be able to subsequently review my actions.

Working in this exploratory manner proved challenging at times for

both the practitioner and the novices, bringing to mind Rittel & Webber's description of town planners undertaking "an argumentative process in the course of which an image of the problem and of the solution emerges gradually among the participants, as a product of incessant judgment, subjected to critical argument" (1984 p136). This process was made possible by working with a group of close acquaintances with whom I had easy communication. In the next chapter I describe my second practical project in which I experimented with a less intrusive, observation-based approach to elicitation, working with participants with whom I was not closely acquainted.