

Wood N & Horne G (2008). *The new journeyman; the role of an expert learner in eliciting and transmitting skilled knowledge*. Proceedings of the Design Research Society Conference, Sheffield, July 2008. Available from www.nicolawood.net

The new journeyman: the role of an expert learner in eliciting and transmitting skilled knowledge.

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Abstract

This paper presents interim research findings of a project which seeks to elicit the skilled knowledge of master craftsmen through use of an expert learner (Horne) acting as intermediary between the craftsmen and a designer (Wood) creating a multimedia resource to support those wishing to learn the skill. It builds on previous research that evolved a set of principles for the design of multimedia learning materials (Wood & Rust 2003) and moved on to develop techniques for elicitation of expert knowledge from craft masters (Wood 2006).

The skills involved in undertaking such craft practice involve a high degree of tacit knowledge which is internalised and frequently difficult for the craft expert to articulate. The expert learner has the ability to learn new skills with minimal instruction then articulate those skills before they become too internalised. The role of designer is to assist with this articulation and develop interpretation suitable for transmitting the knowledge to novice learners.

This research focuses on the skills of traditional custom knife makers in Sheffield; Horne has worked alongside two traditional craftsmen, video recorded by Wood. Together they have collaborated to analyse the recordings and develop learning materials to disseminate the craft skill. These are currently being developed and tested using a small group of learners with some one-to-one teaching followed by self-directed development work using an on-line resource.

The main finding for this stage of the research was that, as Horne had relatively recently acquired this knowledge, it had not become too internalised and she was able to rapidly adapt her understanding of it to improve transmission to the learners in a manner that had not been demonstrated by more experienced craft practitioners. The interactions between Horne and the learners were mediated by Wood, facilitating reciprocal reflection between them and designing 'bridges' to help transmit the knowledge to future generations of learners.

Keywords

multimedia design, on-line learning, tacit knowledge, craft skills, knowledge elicitation

The central problem behind this research is, from the perspective of a multimedia designer, how to understand and transmit the expert knowledge of skilled craftspeople, with a particular interest in craft skills that may be disappearing despite there being people interested in preserving and learning them. The focus of the research is traditional custom knife makers in Sheffield, which was once the centre of the UK's knife making industry but has now declined to just a few master craftsmen. The learners taking part in the

evaluation of the learning resource come from a new generation of creative metalworkers whose interests lie in adapting traditional skills to new craft practices.

Whilst the subject of study is traditional craft skills, the research could have wider applications in both contemporary craft practice and other practices involving skills with a significant element of tacit knowledge such as healthcare, performance, catering, construction and sport. It potentially has applications in any area where tacit understanding needs to be developed as it leads people to attend to the tasks and activities of professional work not purely as a means to a practical end, but as bridges to a richer understanding of the practice.

The aim of the research project as a whole is to develop a multimedia learning resource to support contemporary craft practitioners who wish to draw on traditional knife making skills and apply them in their practice. This paper presents interim findings on the joint work of a designer (Wood) and an expert learner (Horne) to elicit and interpret the practice of traditional craft masters in the knife making trade. The elicited knowledge has been recorded as a prototype learning resource, primarily in the form of illustrations and text, supported in places by video¹.

The initial development and testing of the resource was undertaken by Horne working directly with a small group of learners. The main finding for this stage of the research was that, as Horne had relatively recently acquired this knowledge, it had not become too internalised and she was able to rapidly adapt her understanding of it to improve transmission to the learners in a way that had not been demonstrated by more experienced craft practitioners. The interactions between Horne and the learners were mediated by Wood, facilitating reciprocal reflection between the them and designing 'bridges' to help transmit the knowledge. The final testing of the resource will take place with a group of learners who are entirely self-directed.

Transmission of tacit knowledge

The highly tacit nature of craft knowledge leads to it being largely internalised; the theory governing craft practitioners' actions is often only known through their undertaking those actions (Polanyi 1966, p17). On a purely functional level, tacit knowledge could be seen as offering advantage to the craft practitioner by reducing cognitive load, freeing the mind from one level of a task to enable thought to be directed at another.

At a deeper level, Polanyi (ibid p10) considered two terms of tacit knowing; the proximal (situated nearer to oneself) and the distal (situated further from oneself). He described the functional relationship between these terms as knowing the proximal only by relying on our awareness of it for attending to the distal. We only know the whole of the theory that governs our practice by relying on it whilst in the act of undertaking that practice. This explains the difficulty craft practitioners have describing the theory that governs their actions; it is often only known through attending to their practice. Polanyi (ibid p17) further described the phenomenal structure of tacit knowing as attending from the proximal to the distal. We attend *from* the theory *to* things seen in its light, hence theory could only be learned through practising its use, a process he called interiorisation.

Polanyi also considered the reverse of this process, where the focus of the practitioner's attention was returned to the theory. The immediate result of the action becoming proximal and the theory distal was often a complete loss of meaning; "By concentrating attention on his fingers, a pianist can temporarily paralyse his movement" (ibid p18). However, Polanyi believed the long-term effect need not be negative, destructive analysis of such knowledge followed by re-interiorisation could result in a more secure and accurate basis for practice (ibid p19).

¹ The resource is structured according to the framework developed and tested during previous research (Wood & Rust 2003, Wood 2006).

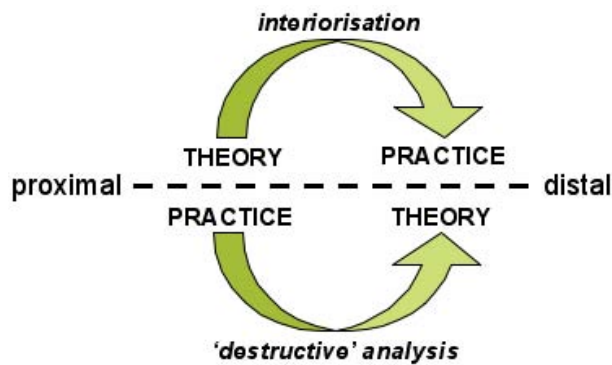


figure1: My interpretation of Polanyi's theory².

This can result in craft practitioners having difficulty articulating their knowledge other than through demonstration and even holding erroneous views of their craft skill (Wood 2004). The problem in the context of the subject of this research is further exacerbated by there being few craft masters left to pass on the knowledge and those interested in learning the skills not having the time for traditional apprenticeships (Heritage Lottery Fund 2002).

Polanyi (1966, p30) described the means by which such knowledge was learned as a process of indwelling: the novice seeks to dwell in the actions of the expert through observing them and taking action to imitate them. However, Wood (2006, p126) observed that, at an early stage of learning, it was very difficult for a novice just to observe and imitate successfully. All the novices struggled to imitate what they had seen in the videos and one, when he chose to experiment with very little guidance, became exhausted and demoralised. The novices who made a more successful start to their learning used guidance in the form of the interpretation of knowledge elicited from the craft expert. This interpretation helped the novice dwell in the expert's actions by offering explicit concepts as a bridge over the gap between their personal knowledge:

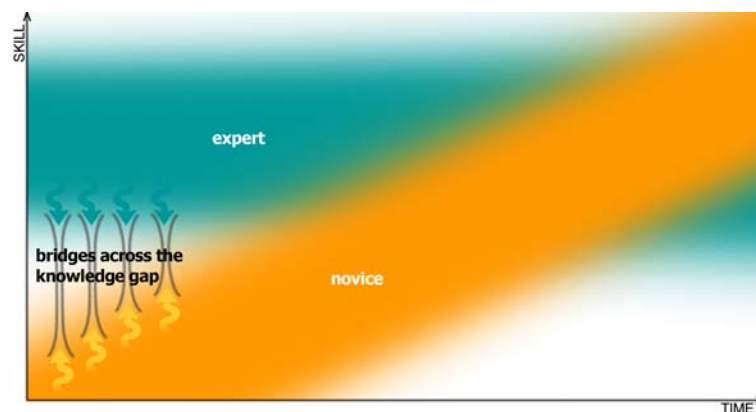


figure2: the knowledge gap between craft novice and expert³

The expert might start by demonstrating but, rather than leaving the novice to try and interpret what they see, the expert might provide a commentary, thus attending from his practice to his theory. The expert's commentary will use explicit concepts in an attempt to bridge the gap, and the novice will need to undertake some form of action in response to this received knowledge, primarily imitating the expert, but in a reflective manner. The expert in turn should observe and reflect on the novice's response, considering revising his interpretation until a consensus of understanding is reached and the gap is bridged.

² This is purposefully represented as two separate processes above and below the dotted line as I do *not* wish this to be interpreted as a cyclical process.

³ These illustrations are not intended to be measurable graphs, but more a visual aid, a representation of my understanding.

For example an expert wood turner (Wood 2006, p65) used a series of explicit concepts to try to communicate to a novice how to achieve the correct angle so the turning tool cut cleanly. His first explanations were in terms of 'twisting' and 'pivoting' the tool, but the novice found the language confusing, so he tried again in terms of the angle of the tool: showing where 90° and 0° were and telling him to aim for 10°. The novice was then more successful, but the expert was not entirely satisfied and later came up with a new explanation, dividing the movement into three which subsequently proved more successful in conveying the concept to the novices:

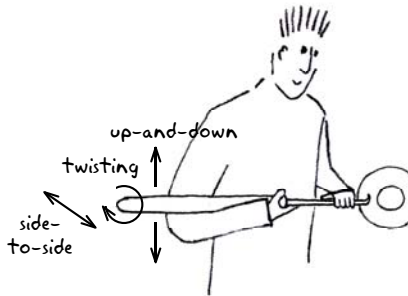


figure3: the three movements of the turning tool described by the expert.

This does *not* imply that the tacit knowledge of the expert was made explicit. The knowledge that guided the angle at which the expert used a tool was largely internalised and could have been influenced by a rich variety of factors with varying degrees of importance; the type of timber, its moisture content, the sharpness of the tool, etc. At one stage when I was observing him, the expert told me that he had altered the tool angle because the wood shavings were spraying in his face. These factors are not the expert's tacit knowledge, they are explicit concepts which can help the expert articulate his tacit knowledge; bridges across the knowledge gap.

The role of the expert learner

Whilst engagement with novices has proved an important factor in turning an expert's attention to the theory governing their actions, there is a tendency for them simply to correct the novices' 'mistakes' at face value rather than trying to understand the reasoning behind them, creating a defensive attitude in the novice (Schön 1987, p136). The novice needs the expert to engage in reciprocal reflection. They want the expert to view their actions in response to instruction as revealing the meaning the novice has constructed for that instruction. They want the expert to observe their actions, reflect and modify the instruction until there is a convergence in meaning (ibid, p104).

It takes a fairly self-confident and assertive learner to undertake this task; an expert learner, one with some existing knowledge in the field, with some experience of trial and error learning. An example of such a learner comes from Wood's previous research when she worked with a clog maker who demonstrated these abilities. The learner had originally taught himself the basics of the skill, then received tuition from two craft experts, the first of whom he felt was not giving him useful feedback which prompted this incident:

I was working over at Tannoy ... in the workshop there and [the craft expert] was training me. He went off for lunch and I'd started a sole and he said, "Finish it by the time I come back." ... So I went rummaging around and found one of the soles that he'd finished and I gave it to him and I said, "What do you think of this?" "Aye," he said. "It's not very good see, 'cos ..." this, that and the other. However it was one of his own soles he'd cut. He couldn't tell and I said, "That's one of yours mate." I don't think he ever forgave me for that! (Wood 2006, p103)

An expert learner is identified within the educational context as one who is "confident, informed and inquisitive, taking on responsibility for managing their own learning" (QIA Quality Improvement Agency, n.d.) They possess an ability to be conscious of their own

learning and reflect upon their own learning process as a means of identifying their most effective learning strategies (Ertmer & Newby 1996).

The expert learner can be seen as the modern-day equivalent to the traditional journeyman. In traditional apprenticeships a journeyman was at an intermediary stage between apprentice and master. Having completed their apprenticeship tied to one master, they travelled to work with different masters, disseminating practices and employing a reflective, artistic engagement with their work that allowed new ideas to emerge (Epstein 2004).

The role of the designer

The role of the designer in this transaction can be viewed as facilitating the process of reciprocal reflection between expert and novice. The prototype learning resource can be seen as a series of experimental bridges across the gap between the expert's and the novices' craft knowledge and the designer works with both sides to modify and refine them until they are meaningful to both.

In the example above where the wood turner was seeking a useful description of the angle at which the turning tool was to be held, the novice learner was unable to negotiate a suitable explanation himself. The expert was able to give him the feeling of the tool cutting correctly by putting it in the correct position in the learners hands, but afterwards the learner was unable to replicate it. It was subsequent reflection on behalf of the expert followed by work with the designer that enabled an explanation to be uncovered and developed into interpretation for the learning resource.

Practical work

The expert learner for this project is Horne, a contemporary knifemaker with a background in metalwork and jewellery whose earlier work focussed on creating different forms of knives in an innovative and exploratory manner. She also has a background in research having studied solid state diffusion bonded Damascus steel and its role within custom knifemaking for her PhD.



figure 4: knives made by Horne (left to right) little snips in cast stainless steel, folding scalpel in cast stainless steel with disposable blade, disc knife in Damascus steel with silicon/magnet holder

Horne's interest in knife making came from her knowledge of the traditional Sheffield knifemakers and over the last eight years she has spent time getting to know them and their craft skills. Prior to this project she had made several folding knives, but their design had been constrained by the limit to her understanding of their construction.

During this research Horne has worked under the supervision and instruction of an expert knife blade grinder and an expert folding knife maker whilst Wood has recorded the activity on video. Together they have collaborated to analyse the recordings and develop learning materials to disseminate the craft skill. A small group of new learners has been recruited both to test the prototype learning materials and stimulate Horne to reflect further on her own learning experience.

The two craft experts adopted very different approaches to the training sessions providing different experiences for the expert learner. The grinder both gave tuition and provided

Horne with the time to experiment and understand, offering Horne the opportunity to set off on an ideal learning path. The folding knife maker taught in a more traditional manner, leaving little chance for any experimentation or questioning. To make up for this Horne undertook experimental making at the University's workshops guided by the recordings made with the craft expert. The outcomes of this were further examined through teaching a selection of novice learners.

Brian Alcock, traditional knife grinder

Brian Alcock began working as an apprentice grinder in 1957 when he was 15 years old. He was apprenticed to his father who was the main gaffer at the grinders 'George Barnsley & Sons'. In his spare time, he was allowed on the wheels and would hand grind. After three years with 'George Barnsley & Sons', Alcock set up a grinding workshop on his own and continues hand grinding a wide variety of tools, one of few remaining craftsmen practicing this trade in the city.



figure 5: (left to right) Horne grinding, Alcock's workshop, blades from the manufacturer at the rear, ground blades at the front

Whilst the work with Alcock is incomplete because we have not yet been able to create interpretation and experiment with transmitting the knowledge, it has had other outcomes for the research. Firstly, it provided a useful environment in which to test equipment and working methods. Secondly it provided a good example of a type of teaching and learning Horne had identified as being likely to lead to successful skill acquisition which will be discussed in the following section.

The learning took place as a series of one day sessions, each videoed in its entirety by Wood. After each session Wood would process the video by watching it through and writing event logs (Wood 2006, p21), then select a sample of discussion points illustrated by video clips where necessary. These were used to stimulate discussion with Horne about what needed to be achieved during the next session.

As far as we are aware Alcock has no experience of teaching his skill, but he proved a patient and sensitive tutor. He his method was to move fairly rapidly from demonstration, to offering guidance whilst Horne practiced, to leaving Horne to experiment and question or ask for help when she needed. During the training period Horne gained a good understanding of the tools and techniques involved.

To complete this part of the project we need to work with the type of belt grinding equipment that most small-scale knife makers would have access to. We had planned to do some comparative work between the two types of grinding with a younger Sheffield grinder who also makes fixed blade knives. He learned the trade from his father who had come through a traditional apprenticeship and uses both grinding wheels and belts. Unfortunately through pressure of his work we were unable to work with this maker at this stage of the project, but if time allows we hope to pick this back up towards the end of the project.

Trevor Ablett, traditional folding knife maker

Trevor Ablett began work as apprentice to his uncle, Emil Berek, in 1957 when he was 15 years old. At that time, Emil had 10 workers and was producing working folding knives under the 'JY Cowlshaw' brand. Ablett worked there for ten years before moving to 'A Meyer' doing more specialised work; gimping and glazing open razors. When his uncle died in 1975, Ablett and his brother took over the business and continued making working folding knives with two or three men that had worked with his uncle. In 1980, Ablett started working on his own, in the manner that he still does today.



figure 6: (left to right) Trevor Ablett, parts of a traditional folding knife, set of "Ettrick" folding knives made by Horne under Ablett's guidance

Horne has worked with Ablett quite frequently over the last 5 years, but has only worked on large batches of knives for random small parts of the production process, so for this project he agreed to guide Horne through the complete process step-by-step. He did this by working on an identical knife, demonstrating and getting Horne to imitate until she did so to his satisfaction, then moving onto the next step.

Again, the learning took place over a series of one day sessions, with each one being video recorded and event logs written between times. However, Ablett's attitude to the process left little room for any sort of experimentation or questioning by Horne. He was unable to understand the importance of the learning process and simply wanted the knife to be made successfully. As Wood has previously observed in similar circumstances (Wood & Rust 2003, Wood 2006, p63) he would frequently take Horne's knife and complete operations himself, or do a little more to it after she had finished, to ensure it was a good knife when completed. As discussed above, this style of learning is likely to lead to a learning path that is constrained by the expert's knowledge.

To break free of this and convert the process to one suitable for small scale production largely using hand tools, Horne firstly spent some time making knives in the University's workshop from parts supplied by Ablett, then guided some learners through the process. Throughout all these sessions, Wood videoed and produced event logs to generate and update interpretive material.

As a starting point, Wood had produced a simple flow chart of her observations of Ablett's procedure and Horne made a knife working through it, adjusting it to make it more streamlined for making individual knives and changing certain processes for use with hand tools. Then Horne made a second knife following the new procedure to check for problems or inconsistencies.

At this stage Wood made a first set of worksheets, illustrating the procedure with simple line drawings, which in previous research (Wood 2006, p49) had proved most effective and popular with learners. These were then initially tested by Horne guiding two learners through the procedure using them. The first had a relatively high practical skill level; a professional craftsman, but someone who had not made a knife before. This highlighted several key skills which needed more detailed interpretation. The second had a far lower practical skill level and this again highlighted several areas where more detailed interpretation was needed.

Finally Horne made a small batch of six identical knives which produced examples of each of the different issues that arise with the folding mechanism on such knives and ways of

overcoming them. These were added to the interpretation which was then set out in digital form using a password-protected wiki⁴, structured according to the framework developed during Wood's previous research (Wood & Rust 2003).

Three new learners were used to test this material, which was used in printed form as a basis for a session in which Horne guided the learners as a group through the making of a knife each. The aim had been that these learners would take more knife parts away and use them to make knives in their own time, supported by the on-line resource. Unfortunately this did not work out at this stage, partly due to the learners not having access to necessary equipment and partly because of an initial reluctance to use the wiki⁵. More recently two new groups of learners have been recruited to test the on-line materials and early indications are that they are starting to use the wiki both to find assistance and to show their progress to the rest of the group.

Discussion

To build their own skill a novice needs to accumulate their own tacit knowledge through undertaking action. This might be in the form of a direct response to input from an expert as discussed in "Transmission of tacit knowledge" (above) or it might be more experimental. However, what makes it effective action is the degree and type of reflection that goes with that action.

In this section the illustrations used above are developed to consider the possible effects on the novice of different modes of reflection, then we speculate on how changes in the predominate mode of reflection over time⁶ might influence a novice's learning path.

Reflection

Schön (1983, p62) defines the action present, the period of time in which the actions of the practitioner could make a difference to the situation, as forming the boundaries of the practitioner's knowing in action. If the figure on the right is thought of as being three-dimensional, the figure on the left can be seen as a slice through it at the point of the action present (A-A):

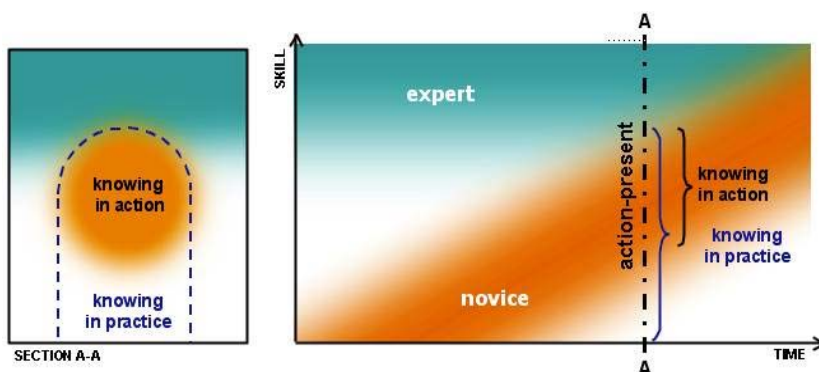


figure 7: the relationship between knowing in practice and knowing in action

The first mode of reflection identified was described by Schön as reflection *on* action (1987, p26) and this closely relates to the approach described by Dewey as 'stop, look, listen' (1916, p235) and Polanyi as 'destructive analysis' (1958, p50).

⁴ On-line software that allows users to collaboratively create, edit, link, and organise the content of a website.

⁵ Further discussion of this is contained in another paper in this conference: Fisher, Keyte & Wood *Hands on hands off: craft learning and virtual community*.

⁶ N.B. use of the term 'predominate': the skill of the learners will operate at many different levels and at any one time they could be using more than one mode of reflection, but at any time one will be a dominant mode.

Reflection on action occurs when an unexpected event causes the practitioner to stop, look at what they are doing and think about what has happened and how to proceed. During this process the practitioner reconsiders their knowing in action, identifies a possible solution and returns to the action-present to test the solution. The result of this will be an overall increase in the practitioner's knowing in practice although, with the thought process occurring outside the action present, the portion of this which is knowing in action will tend to remain the same:

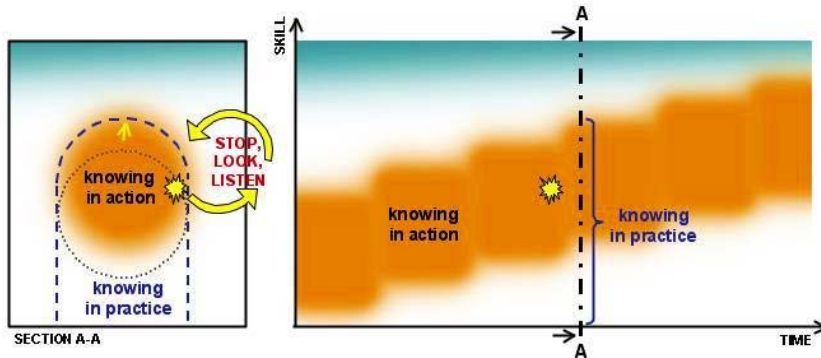


figure 8: mode I - reflection on action

The second mode of reflection identified is an element of what Schön (1983, p62) referred to as reflection *in* action and is entirely contained in the action present: rather than 'stop, look and listen' the practitioner remains absorbed in his task.

Primary reflection in action is where the unexpected event causes the practitioner to become aware of the procedure he has tacitly been carrying out, use his understanding of the surprise to construct a new understanding, then test this with an on-the-spot experiment. This allows the practitioner to revise his knowing in action, but now with a smooth upward progression as the process is entirely carried out in the action present:

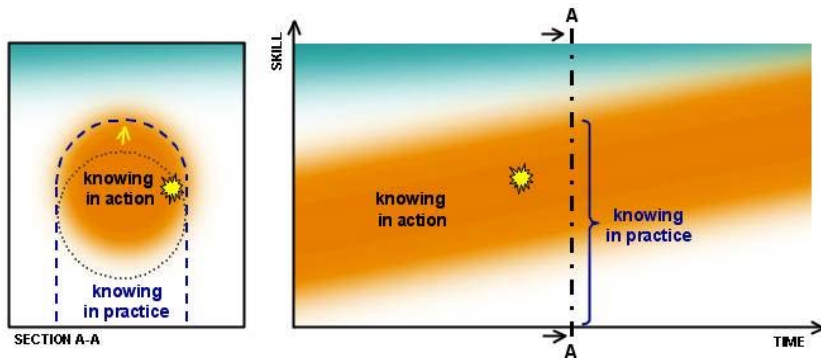


figure 9: mode II - primary reflection in action

The third mode of reflection identified is described by Schön (1983, p63) as an advancement of the above process of reflection in action. The practitioner finds that primary consideration of the unexpected event does not lead to a new understanding, so instead finds a new way to frame the problem, to see if this will bring about an alternative understanding of the situation. If successful the result will now be an increase of knowing in action rather than just a shifting upwards:

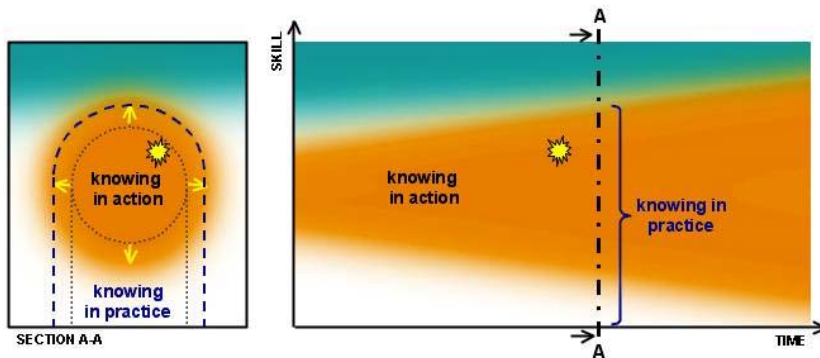


figure 10: mode III - secondary reflection in action

The side-effect interestingly implied by this diagram is that knowing in action becomes a larger portion of knowing in practice, demonstrating the observed tendency of skilled practitioners to become increasingly absorbed and less able to articulate their practice over time.

The fourth mode of reflection identified is derived from Argyris' concept of double-loop learning where, more than just reflecting on the actions being carried out, the practitioner undertakes action that challenges their established view of their whole practice (Argyris 2003). Through their action, the practitioner is reflecting on the whole of their knowing in practice, not just their knowing in action, leading to a simultaneous increase in both:

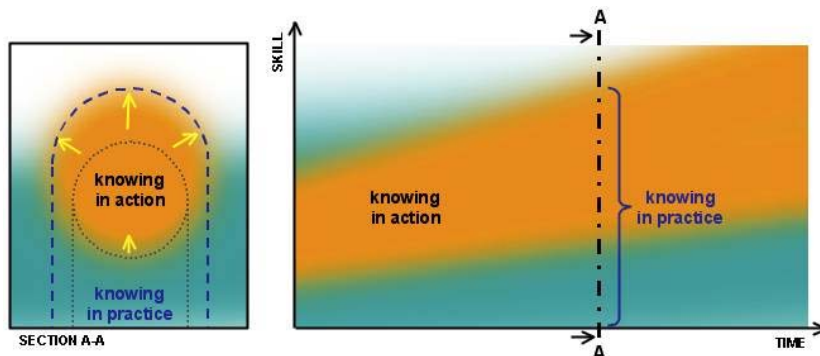


figure 11: mode IV - double-loop reflection

This takes skill development away from a narrow, problem-solving perspective, towards a more holistic concept of the practitioner being able to re-assess and move forward knowledge within their practice generally. This mode of reflection is most likely to enable a practitioner to break the boundaries of the established knowledge of previous master craftsmen and establish new knowledge.

Learning paths

Looking now at changes in the predominant mode of reflection over time provides an indication of the likely learning path of the novice. In the work with the knife grinder, Horne was provided with a good balance of guidance and time working on her own, allowing time for both reflection on action and reflection in action. This more open style of learning is most likely to lead to breakthroughs where mode IV reflection predominates:

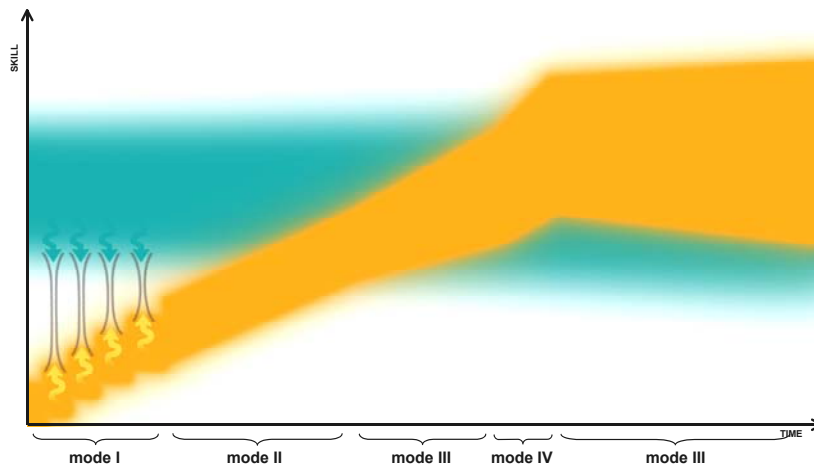


figure 12: learning path with novice exceeding expert's skill level

However, such double-loop reflection appears to be an occasional and transitory phase; in regular practice reflection in action seems to predominate, leading to skills becoming increasingly internalised and tacit.

In the work with folding knife maker, Ablett was quite fixed in his perception of his craft skill and offered Horne little opportunity for experimentation or to engage with reciprocal reflection. The predominate mode of reflection for such a learner would initially be mode I, as they make use of received knowledge from the expert. Over time they would develop the ability to reflect in action, firstly with mode II and then mode III as they made use of their own experience to add to their theory:

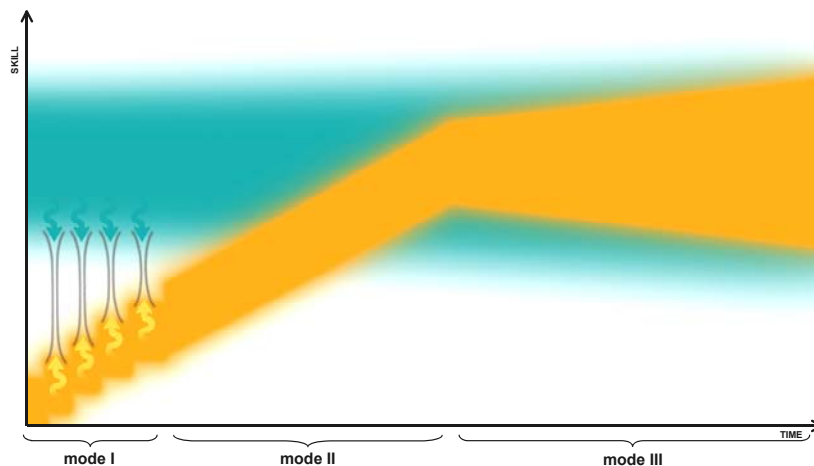


figure 13: learning path with novice attaining expert's skill level

Given such constraints placed upon the learner 'breaking out' above the level of the master, characterised by mode IV (double loop) reflection, seems unlikely to be a frequent occurrence or to achieve only minor increments in the level. As Christopher Alexander (1964, p34) commented about such traditional craft practitioners: "... actions are governed by habit ... there is little value attached to the individual's ideas as such. There is no special market for inventiveness. Ritual and taboo discourage innovation and self-criticism."

As an alternative Horne experimented on her own, a process Schön (1987, p120) called reflective imitation where the learner initially suspends any disbelief, puts their trust in the expert and imitates their practice, but in a reflective manner. The material being assembled by the designer for the learning resource allowed Horne to check back on what she had been taught and the presence of the designer and the recording process as she was experimenting served to encourage and assist this reflective process.

There is a danger that such self-directed work can lead to learners 're-inventing the wheel' or becoming dispirited and giving up (Wood 2006, p66). However, the determination required could also result in a greater ability to see through the difficulties. An early reliance on the feedback from their own experience may mean such learners can progress with less received knowledge and are more absorbed so could be more likely to dwell in their craft and break out from the established boundaries:

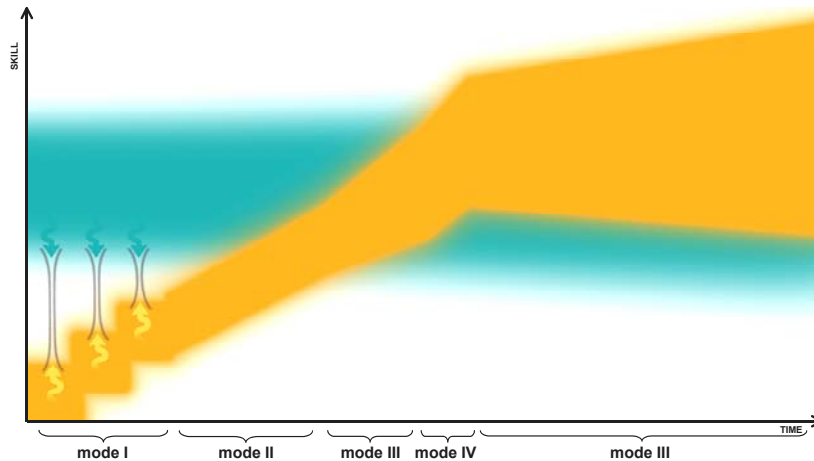


figure 14: learning path of self-directed learner

However, rather than continuing working on her own, further critique was stimulated by Horne working with novice learners; some who were complete beginners, and some with some pre-existing metalworking skills. Both played an important role; the more novice learners uncovered areas of tacit skill which needed more detailed interpretation and those with a greater skill level were more likely to challenge the reasoning behind basic techniques. Again the presence of the designer, the recording process, and common aim of creating materials for a learning resource served to encourage and assist with Horne's reflective process.

The result is a complex learning path, starting with 'short step' mode I reflection under the guidance of the expert (figure 13), followed by a self-directed learning path (figure 14) where the central mode III sector is interspersed with interactions with learners stimulating more mode I reflection. The role of other learners here can be seen as encouraging mode I reflection *on* action alongside the mode III reflection *in* action, which in turn helps overcome the problem of new knowledge becoming deeply internalised and difficult to communicate. Whilst this might prolong the learning path of the expert learner they are still ultimately as likely to experience mode IV reflection and rise above the skill levels of their craft masters.

Conclusion

Our prime concern before starting this project was to get the craft experts to engage in reciprocal reflection *without* too much of a direct challenge. The example with the clog makers quoted above was taken in good humour, as was another incident where Wood intervened to show an expert video of himself in support of a learner's challenge. The learner was copying the way he had seen the expert hold a tool in a video and the expert was telling him it was incorrect. However, such good humour cannot be guaranteed and we felt a less confrontational approach would be better.

In the work with the grinder the problem did not present itself because of the experimental space the expert allowed the novice. For example, after getting to grips with the technique of grinding blades with a straight cutting edge Horne could not see how to adapt the technique to grind one with a curved cutting edge. Alcock (the craft master) would only say that it was just the same and that she should just do it. Once he persuaded Horne to

experiment, she gained an initial feeling for how to adapt the technique and Alcock could then communicate visually the motion she needed to grind into the curved portion of the blade.

In the work with the folding knife maker, the issue was side-stepped by Horne experimenting with techniques away from the craft master and testing her knowledge with other learners. Effectively she was then playing the role craft master to their novice, but because this was relatively new knowledge she felt little need to defend it and was quick to engage in reciprocal reflection.

Wood (2006, p132) had speculated on the importance of the influence of other learners during the journeyman stage, thus:

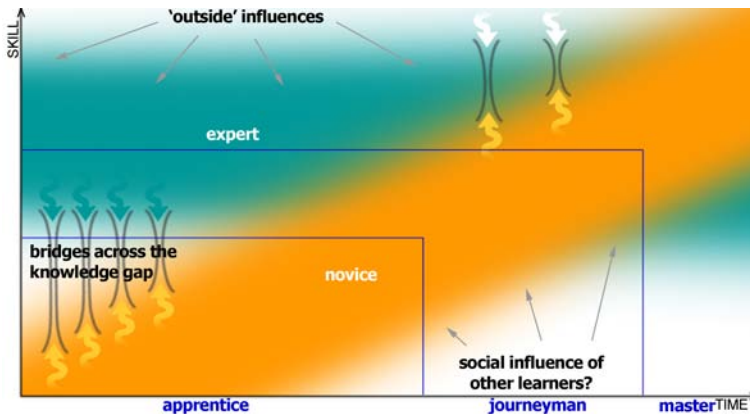


figure 15: phases of learning and possible routes of received knowledge

These interactions between the journeyman and the other learners were mediated by the designer, facilitating reciprocal reflection between the two and designing 'bridges' to help transmit the knowledge to future generations of learners.

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