Encouraging the Development of Design Expertise through the Construction of Video Stories about the Design Process

Janet McDonnell, Peter Lloyd and Rianne Valkenburg

Theories about experiential learning and expert performance place reflection as a vital mechanism which operates at different levels according to whether we are responding to a situation as it unfolds or critically reviewing past events to make sense of what occurred. Video recordings already play a useful role in reviewing events in many situations. Recently it has become practical to edit digital video footage using mass market, easy to use software, this has opened up new opportunities for amateur production of video stories. We describe work carried out at the Technical University Delft with small teams of industrial design students on the point of entering professional practice in which the potential of video story-making for supporting the sort of critical reflection necessary to evaluate design experience was explored. We conclude that the process of story construction presents rich opportunities for making sense of design education and experiences of design practice.

The ability to make coherent connections between events is a fundamental cognitive mechanism for making sense of the world, just as giving plausible accounts that are intelligible to others is fundamental to social interaction. In professional practice, those with specialist expertise need rhetorical skills, including the ability to tell a 'good story' if their ideas and recommendations are to be understood by others, accepted by them and acted upon.

In this paper we set out the theoretical basis for believing that story-making is one way of assimilating experiences from design education and design practice so as to deepen understanding of the process of designing with others. We draw attention to the links between narrative construction and the kind of reflection about experience that takes place to support learning that characterises expert performance.

1. Introduction

Recently it has become practical for amateurs not only to shoot good quality video footage but also to edit it, using mass market, easy to use software. This has opened up new opportunities for non-professional production of video stories. To explore a number of research issues in design education, design practice and design processes a two-week course, referred to as VALiD (Video Assisted Learning in Design) was offered to industrial design engineering students who were close to the completion of their undergraduate studies and on the point of entering

professional practice. For the participants the workshop course was intended to develop their understanding of the design processes of small design teams. The workshops were presented both as an opportunity for these newly qualifying designers to question their practical and theoretical design education by making their own story about the design process and to learn new skills in working with multimedia.

We describe the VALiD workshops where students used a digital camera to record what they were doing as they carried out a short design task and then used the video footage to construct a short video story of the design process. Elsewhere, we have discussed the structures of the stories the teams of students produced (Lloyd et al. 2003). Here we discuss what sort of evidence there is to suggest whether, and to what extent, story-making facilitates reflection at the level necessary for expertise building. This discussion is followed by an account of the principle activities associated with the story-making process during the second week of one of the workshops. These are planning how to watch the video record of the design task, designing the story together as a group, and editing the video footage to construct the video story. Interspersed with these activities were sessions for reflection. We attempt to give a flavour of the influence of the workshop on some of those who took part using the participants' own expressed perceptions of the experience. Finally, we assess the tentative study that the workshops represent, we discuss the practical benefits which similar workshops might offer and suggest some areas of further inquiry.

2. Theoretical background

2.1 Developing design expertise

Making sense of design education and coming to terms with the conflicts it raises with design practice and the on-going process of assimilating design experience is all part of a designer's development. A common pattern of skill acquisition can be discerned in a wide range of disciplines which, like design, require individuals to handle unstructured problems. The Dreyfus brothers describe five stages in the progression from novice to expert (Dreyfus and Dreyfus 1986). These can be very briefly summarised as follows: novices use a restricted set of context-free rules to decide what to do; advanced beginners start to make use of experiences of rule application to refine rules to fit different situations; those with competence consciously plan and organise choices on a rational basis; proficient operators use intuition to see what to do but plan how to do it; and finally experts exhibit fluid performance. At about the competent level an important change takes place in the relationship between the skilled individual and the task. There is a certain detachment in the behaviours of novices and advanced beginners but one who is competent has to make choices, to decide what is important and thus has the beginnings of a sense of involvement and of responsibility. At the competent level, the individual makes conscious choices about what to do. The proficient performer can assume a perspective; certain features of the problem situation stand out and certain of them are ignored. In the course of events what is salient is modified, plans and expectations change; the

perspective will shift. There is, therefore, a progression from the analytical behaviour of a detached follower of abstract rules to involved skilled behaviour.

Although a designer can be described as one who attempts to meet a situation not to master it (Potter 1980), this 'meeting' demands of the designer that s/he impose coherence on a design situation – making an impression on it – and as a result the designer must take responsibility for the order s/he imposes (Schon 1983). Developing a sense of engagement with the design situation demands commitments to be made and these in their turn give the designer a sense of responsibility for the way he has engaged with the situation. Being able to view designing in a rich variety of ways, and importantly understanding that these viewpoints are not resolvable into a single 'objective' perspective is an important step in maturing as a designer. It is important to see that the difficulties design students have in resolving theory with practice for example is not a failure of design education per se but a necessary stage of sense-making and expertise development.

Students are introduced to a rich variety of ways of seeing the design process during their formal design education. In some situations it is helpful to view design as something that should proceed in orderly phases, in a structured manner, with some iteration between stages (e.g. Pahl and Beitz 1995); as a series of activities which encourage or support divergent and convergent thinking (e.g. Jones 1992); that it is about co-evolving requirements and solution ideas (e.g. Cross 2000); a social process of constructive, participative decision making (e.g. Rittel and Webber 1973); that it is solution centred enquiry (e.g. Lawson 1997); a process of problem decomposition; an exhaustive search among solution possibilities; the creative act of an individual; and so on. Different design paradigms are valuable for different purposes, they are not all mutually compatible nor is any one of them useful for understanding all situations (Stumpf and McDonnell 2001). A rich understanding of designing does not come from reading about alternative ways of describing what goes on. Roosenberg and Eekels' undergraduate text (1994), for example, presents treatments of design covering most of the perspectives we have listed. It is not a question of lack of exposure to design paradigms that we are dealing with when we talk about expertise acquisition as the Dreyfuses characterisation makes clear.

The sort of changes in the structure of knowledge which takes place as a practitioner moves from advanced beginner to competence and beyond arise from experience in making judgements about importance (of events, phenomena, etc.) and the weighing up of contributory factors. At a certain point in expertise development, a sense of what is important in a given situation becomes necessary as a means for organising what is known. The knowledge needs to be structured for use, strategies for approaching situations have to be developed, this, and planning, characterise the transition to the level of competence and beyond.

2.2 Reflection mechanisms in learning from experience

Theories about experiential learning (e.g. Kolb 1984) place reflection as a vital mechanism in learning that operates at different levels. Reflection is a kind of standing back, a mental action that distances a person from events so that they can be viewed in a more critical manner. The degree to which this distancing can be thought of as a conscious act depends on the level of reflection taking place. Theorists have offered characterisations of different levels of reflection. In Van Manen's scheme, for instance, thinking and acting on an everyday basis involves the sort of reflection roughly equivalent to that described by Schon as reflection-in-action (Moon 1999; Schon 1983). We shall refer to this as level 1 reflection, although the distancing from events that forms part of the definition of reflection we have given could be said to be absent from reflection-in-action, or at least not visible to an external viewer, or consciously available to the practitioner, as it is part of the fluid action of engaging with a task.

Further levels of reflection are associated with the development of deeper understanding about what is being reflected upon; "deeper" learning from experiences. For example, staying with Van Manen's levels of reflection, we move on to reflection on specific incidents or events (level 2). This is loosely Schon's reflection-on-action, although depending on which of the descriptions Schon gives is used, reflection-on-action also might be part of level 1 learning. At level 3 we have development of understanding through interpretation. Ultimately we reach the point where we reflect on the conditions that shape experience. Here is where parallels with the emancipatory qualities of Habermas' method of critique can be made (Habermas 1971). The levels of learning supported by different objects of reflection are shown in figure 1. The figure summarises the sorts of activity taking place, the foci of attention, and characterises the corresponding reflection.

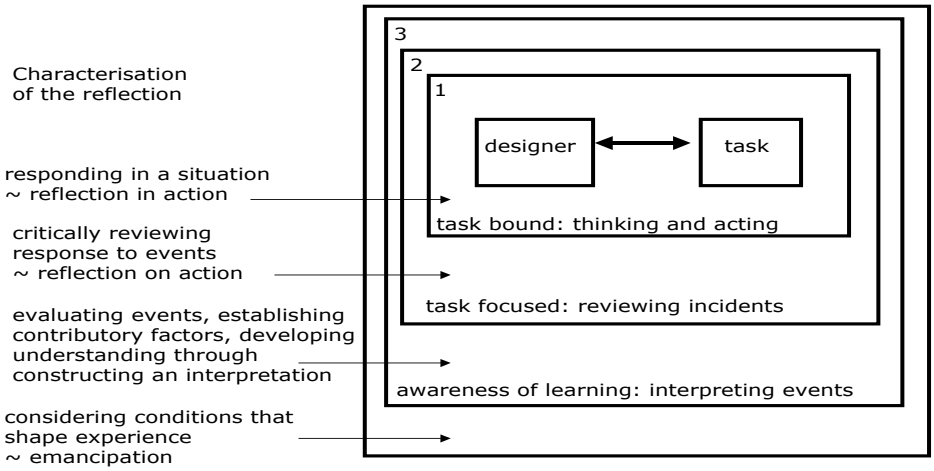


Figure 1 - Learning and reflection at different levels

At level 2 construing is of-course taking place, after all, to paraphrase, when we make sense of something we make sense of it as something (Merleau-Ponty 1962). It is probably more useful, therefore, to see level 3 learning as the development of the richer knowledge structures which are acquired through, and which support the construction of, multiple perspectives or interpretations. It is the command of a discipline that this level of learning implies that underpins the skilled expert performance that we see when practitioners choose ways of making sense of situations that best fits the problems they are tackling.

2.3 The role of narrative in sense-making and in the creation and communication of knowledge.

One hugely important strand in our understanding of sense making is the central role played by our construction of narrative (e.g. Bruner 1990; Weick 1995). Narratives, or stories, have very particular grammatical constituents. Bruner lists these as action directed towards goals; order established between events and states; sensitivity towards what is canonical in human interaction; and the revealing of a narrator's perspective (op.cit.). Thus, the making of a story requires the teller to go beyond passive reviewing of an experience to the construction of an interpretation of it with which an audience can engage. "Stories … gather strands of experience into a plot that produces an outcome"(Weick op.cit., p.128).

The critical difference between level 2 and level 3 reflection, namely the moving from reviewing specific events to constructing interpretations that establish and give an account of the contributory factors, might be encouraged by story construction since a defining purpose of narrative is to explicate; to account for some set of experiences. Further, to make sense to others, the tellers of stories must make a connection between what they tell and what is canonical. They must understand and communicate what is particular about it. "The function of a story is to find an intentional state that mitigates or at least makes comprehensible a deviation from a canonical cultural pattern. It is this achievement that gives a story verisimilitude." (Bruner op.cit., p. 49) To arrive at the point of being able to tell a coherent story demands that construction has taken place, that events can be explained. Stories convey a rich and complex understanding of an event or situation. They are both powerful and accessible means of sharing knowledge and their value and pervasiveness in conveying knowledge is well-recognised (e.g. Nonaka and Takeuchi 1995; Davenport and Prusak 1998).

2.4 Value and limitations of video records in supporting reflection on events

Video recordings already play a useful role in many learning situations. Those who have watched video recordings of themselves presenting a talk can testify to this and the analysis of video records is an established technique for improving expert performance in sport. It is impractical to use video recordings on a continuous basis to review activities for several reasons, not least because we simply do not have time to re-play our

working lives in real time. Even for special events, such as time constrained design exercises, it is difficult for a viewer to pay active attention to what is going on for long periods. Unless we are looking for something in particular, or have some analytical framework which we are actively applying it is difficult not to slip into passive viewing. Unaided we tend only to be able to critically review the specific task we are watching – valuable as far as it goes – but task focussed at best (see level 2 in figure 1). Viewing video does not support abstract conceptualisation per se (a level 3 activity), for this we need some intellectual device such as a model or a theory, a tutor who can point things out, or something else to drive active viewing of the material so that we are fitting what we see together (Goodman 1978) to construct an account of what happened which organises and weighs up contributory factors (Bruner op.cit.). Story-making is just such a constructive activity, because it demands a sense of the canonical on the part of the narrator(s). It forces the story maker to make sense of a particular experience in relation to others.

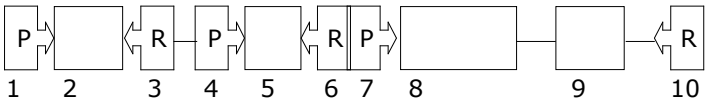
To sum up, in terms of the levels of reflection shown in figure 1, video recording can play an important role in supporting accurate reflection at level 2 but to be useful as a resource for reflection at a deeper level something else is needed. In the VALiD workshops described here, we wanted to see how video recorded material used as a resource for story-making might support reflection at a level beyond reflection-on-action. We now briefly describe the workshop arrangements before moving on to discuss what evidence we have found for valuing story-making.

3. Workshop arrangements

The VALiD workshops, each of which was presented as a full time two week course, were offered on two occasions, five students participated in the first workshop and seven in the second. Each workshop was run in a similar way. The sessions during the first week were used to establish the participants' preconceptions about the design process; to allow each individual to acquire the practical skills necessary for shooting suitable video footage and editing it to tell a story; and to enable the group to become used to working together (McDonnell et al. 2002). At the start of the second week, after a planning session, the group worked together on a two and a half hour design task that they video-recorded simultaneously using a hand-held video-camera (figure 2). The task was to design the packaging for a beer bottle and a glass for a one-off drinks promotion. Students were not asked to include any graphic design but were told to concentrate on producing a recognisable form for the product; that the packaging should be easy to open and close; and that it should be robust enough to carry and protect the contents. It was expected that a cardboard prototype would be completed by the end of the time given for the task and the first group to take the workshop, on whom we focus in this paper, did produce a working cardboard prototype at the end of the design session.

Figure 2 - Working on the design task and video recording the action

The interleaving of moments for reflection (marked R) with the other principal workshop activities during the second week is shown in figure 3.



1 Planning the use of the camera in the design exercise, what to shoot, etc.
2 Doing the design task as a team and video recording it
3 Reflection and 4 planning the story
5 Viewing the video recording together and 6 reflections after viewing the record of events
7 Further story planning
8 Constructing the video-story of the design process by editing the video footage
9 Viewing the video-story, discussing its rationale
10 Reflecting on the workshop experience.

Figure 3 - VALiD workshop activities (week 2 only)

Typically a reflection session would start out with some task-oriented individual reflection followed by sharing of that individual reflection with others. Moon cites numerous studies which suggest that reflection is enhanced where there is some sharing of the reflection with others; the principal benefit is that it helps to get individuals to move beyond sticking at the point of self-affirmation (Moon op.cit.). Specific tasks were suggested for each reflection since it is similarly widely reported that having a stated purpose encourages reflection whereas just building in the

space – giving an opportunity to reflect - is not always sufficient to make it happen effectively even among those familiar with the notion of reflective practice.

The students watched a complete replay of the video footage they had recorded together and planned their video story. To construct the video-story the students used an iMac personal computer running iMovie digital video editing software (figure 4). They edited their material, mainly working in pairs, over the course of three days. Finally, they presented the result, a ten-minute video-story of the design process and gave an explanation of why they had chosen to portray it as they had.

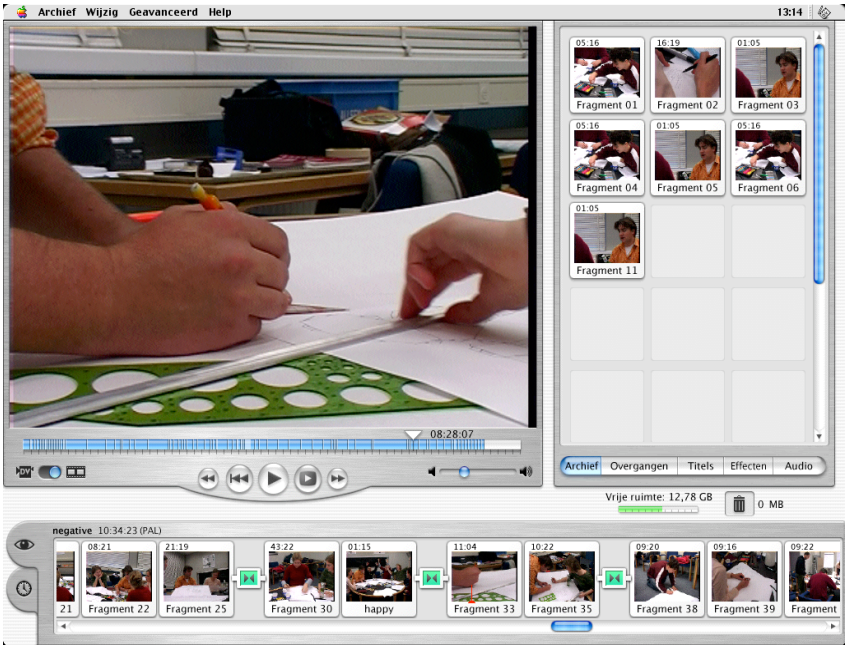


Figure 4 - Digital video-editing software, iMovie, viewer top left, palette of clips top right, below these is the sequence of clips forming the story

All of the workshop sessions took place in a laboratory equipped with two wall-mounted, remote controlled video cameras and audio recording equipment. All sessions including those concerned with planning, reflection, and video editing were recorded to provide a rich collection of research material for later analysis. The descriptions of what took place at the workshop and the examples of dialogue among the students and with the workshop organisers given below are drawn from this material.

4. Looking for evidence of reflection to support deeper learning

As we have seen, story-making requires exercise of just the same sorts of mechanisms as the application of design expertise, namely deciding what fits best; knowing or understanding is about "the discovering and devising of fits of all sorts" (Goodman op.cit., p.138). The exercise of making the video story about the design task pushes the students to devise fits of what they see taking place to questions they want to answer. We give examples of the questions they pose, showing the richness of their variety

in section 4.2 below. The principal activities associated with the video-story-making encourage the students to engage actively with the material they have (the video footage of the design task) testing their ideas about how to structure it, to construct ways of understanding what goes on for themselves individually, together as a group, and for an audience. The most obvious construction is that which we see as the final video story.

4.1 What does the story (making) tell us?

It is interesting that participants in both the workshops decided to give more than one perspective of the design process in their stories. The second group, whom we do not discuss in any detail here decided to tell two stories, one dubbed "positive", a tale of planning, structured stages, decisive, well-founded decision-making, alongside a "negative" story of misunderstandings, time-wasting and mis-communication. They deliberately chose to use the same video-footage in each perspective to accentuate the message that the same design experience can be looked at from different viewpoints - experience and appearance, outcome and process and that these are inherently contradictory.

The first group came up with a completely different plot line from the second group but one which also addresses the inherent contradiction between the ways in which a team design process is experienced by an individual and how it can be made to appear from a product development perspective. In section 4.2 below we use extracts from the students' discussions to indicate how they came to decide what was important, and therefore how to construct the story they decided to tell. Here we just briefly note that their final tale was in three acts, the first tells the story as a structured process of rational decision making, the second attempts to convey the experience of the process for the individuals, a chaotic flowing experience where there is a valuable, legitimate place for emotion and feelings to be engaged. The final act combines the two preceding elements and introduces a strong emphasis on resource constraints.

Having to make critical choices during the planning of this story as a group seems to be what is most valuable for pushing reflection to have the characteristics we see at level 3. The planning of the story is distributed over three workshop activities; first, where the group agree strategy for watching the video footage (activity 4 in figure 2), second, after watching the video footage (activity 7 in figure 2) and then finally, fine-tuning during the editing process itself.

In section 4.2 we show that the students themselves were aware of the value that the story-making task had for making them view the video footage attentively to pursue possible story lines and to see how events could be made sense of in different ways. By looking at the story itself we see some sophistication in understanding the process of product design as a team effort. What we cannot say is whether the participants in the workshop have been prompted to reconsider their prior understanding of design processes by taking part in the workshop or whether they have merely applied the understanding they brought to it. In the next section we look at some of the discussions the group had during the workshop

activities to see if they suggest that reflection at level 3 is being encouraged. We look particularly at the reflection sessions built in to the workshop and at the planning of the video story.

4.2 Characteristics of the reflection taking place

One way to approach looking for evidence that the workshop encouraged reflection beyond level 2 is to see what the discussion during workshop activities is focussed on. We can look to see whether the participants talk about the specific design task (the task focussed level 2 in figure 1) or whether they make generalisations. Do they abstract from the specific task, to construct an explanation of what is going on which indicates that they have weighed up what has happened and made judgements about what is critical and what is important in design processes generally (cf. stories' implicit reference to the canonical referred to in section 2.3)? If they make reference to previous experiences of designing products and working collaboratively on design tasks with others in a team effort, this might be evidence that assimilation of experiences is being prompted. We can also look at the rationale they offer for the story they construct to see whether they seek to express issues about designing in general in their story about the particular design process.

When we look at what is being discussed during the workshop activities we see a clear progression from talk about the design task itself to talk about team design processes in more general and more abstract terms. Here we try to give a flavour of the shift that occurs by giving examples of what is said during activities 3, 4, 6, 7 and 9 of the workshop. Referring to figure 3 we see that 3 and 4 take place after the design task but before replaying the video recording of it; 6 and 7 occur after the video replay session and 9 occurs at the end of the workshop after many hours of work on editing the raw video footage into a video-story. In the first reflection session (activity 3) only one of the five students makes any generalisations when talking about the design task that has recently taken place. She does so apologetically; her abstraction is more a device to avoid getting personal about her colleagues in the team than anything else. One or two of the other students occasionally refers to 'what we have been taught'.

Most of the reflection, just as we would expect, is about the task itself, typically, this from P., 'I think we were very lucky because there is a good atmosphere among us …no one had to explain why we chose <a design feature>'. Here P. is (just) describing what happened as is A. when she talks about her own behaviour which she describes as stubborn, 'I want to try things out <for myself> so I can see I am wrong, not be told by others'.

Activity 4 is concerned with deciding what strategy the group should use for watching the replay of the design task and therefore includes a lot of discussion about planning the story. This task begins to move the conversation about the experience of the design task away from descriptions of isolated events to focus on how it might be coherently be construed in a number of ways. A series of questions that the video-story

might answer are posed, from V. we get, 'Why this group works? What concessions were made? Why you got the role you played?' P. wants to answer a question about the origins of the ideas that go together to make up the elements of the final design concept. A. says, 'I think it was very remarkable that everybody took a role. We can search for where that originated.' M. offers, 'It is good to have a question <when looking at the replay>. Did we plan anything? How does this team work? How did the product grow?'. By setting themselves these questions, the group move themselves towards an active, enquiring stance. Rather than describing surface features of the design process, they place themselves in a constructive frame of mind as they prepare to watch the replay.

It is important to notice here that the group has an open attitude at this point to what story they will tell. Individuals are free to pursue their own sense-seeking goals and to explore potential plot lines. This is an important element in Dewey-inspired theories about what learning is all about. Each individual can pursue their own agenda as well as taking on responsibility for some aspect of the team's viewing strategy. We see that the task of creating a story forces those doing it to look for contributory factors (… to why the team worked well, or what the final product looked like, for example) and to evaluate events, these are the sorts of constructive activities that characterise level 3 reflection (cf figure 1).

After viewing the replay some individuals have radically revised their views about what went on during the design task. This doesn't surprise us as researchers since we are familiar with the poor fidelity of recall of even recent events which video records can reveal. However the students affected are surprised. P. is absolutely astonished to have seen where the ideas for the final design concept originated especially her own contribution to the final design concept. It is she who proposed answering this question as the story line. Her comment is, 'It is strange because I didn't remember that I did agree about this kind of shape…but everybody can recognise in the final product … something that they thought about before.' M. is less amazed but still finds his original feelings about the design task – that it went well – are now far less convincingly held, 'Everyone had in his mind how it went, I thought it went really well, <I just> wanted to review it ,<i.e. to confirm it>, but there was much more discussion … a lot more happened than I remembered, it went less well than I thought.' One of the stories M. is pursuing, as we have mentioned above is, how did the product grow? Constructing an account of this turns out to be very important for his learning as we show below in section 4.3.

V. says, 'I experienced it more or less as I remember it. But now I am looking for something so I see it slightly differently…there were some parts that we didn't notice were so crucial <i.e. during the design task>, someone just said it, and we moved on, which had a big influence for the way the project went.' What A. is drawn to is the amount of structure that can be seen in the design activity. She contrasts this with how it felt to take part, 'The most remarkable thing is the planning, dividing the tasks, and the discussions, and the deciding.' This theme is taken up strongly in the next workshop session (activity 7), the further planning of the story by the group as a whole. They realise that how design tasks appear (e.g.

on their tape) is at odds with how it feels at the time to take part. This theme, of structure vs. fluid, creative flow and exchange of ideas among the team members, becomes central to the story they construct.

During activity 9 the rationale for the video story is discussed and this naturally leads into a reflection on the VALiD workshop as a whole (activity 10). By this point the students make no references at all to the actual design task itself. P., for example, who has experienced somewhat of an epiphany says ' what you have to do more or less is to divide the work, you decide some line <set some constraints>, other people know what has to be done… you know what they are doing but not exactly … you discover new ideas …and when they are done you can discuss them and decide if they are good or not … whereas if I was always present…the ideas would always be mine.' A. offers this analysis, 'what the movie <the video-story> is about is that <designing> is not just the prescribed process units – it is hard normally to make clear that there are some emotional things happening.' She is surprised but pleased that the group all agreed that this was the case and that the story should have this theme. Others concurred using different ways of expressing the same idea.

Editing video footage is a laborious task. It took the students about fifty man-hours, working in pairs, to carry out activity 8. On the subject of this work, when the final video story has been shown (activity 9), M. observes, 'When we start <as design students> we think designing is just making it up, designing is just making decisions falling out of the sky… But if you look at the movie <i.e. the video footage> a hundred times you can explain everything <all decisions>.' The others agree. J. says, 'I think things have changed by watching the video <video footage of the design task> so many times.' They see the deconstruction that takes place during the editing process when they have to attend to fine details of the design task, as a help not only in constructing an account of events but in seeing which are important and how sense can be made of them.

For the four of the five students who have studied Industrial Design at TU Delft working in design teams is a familiar experience. They have done this on many occasions during their education and in design practice during industrial placements. Nevertheless, the story-making has contributed to changing and refining their ideas about what designing in a team is all about. There is also a strong sense of having managed to express something that was there but somehow unresolved or even unexpressed about the tension between the practical experience of designing and the stories that theories tell them about designing. The overwhelming sense in talking to them about their experience is not one of rebellion against design education but of a genuine struggle to make sense of the discrepancies between education and practice, to resolve the objective views of designing products through rational problem solving and structured process stages with their practical experience as creative individuals cooperating socially in design activity.

4.3 Self-awareness of learning

Another sort of evidence that we might look for to support the idea that deeper learning is taking place centres on self-awareness. Emancipatory goals are concerned with self-critique with a view to transformation. This rests on self-awareness, an appreciation that one has learned something. Rather than trying to assess students' changes in perception indirectly by looking at what they say about designing, we can simply ask them. During activities 9 and 10 ample opportunities were presented to share insights with the rest of the group. (Only four of the five students from this workshop could be present at the final activity.) Two students were clearly astonished by the changes in their perception of, and relationship to experiences of designing.

Firstly, M., we have already seen, has noticed, from pouring over the video footage, that all features of the final design for the packaging can be tracked back thought discussions to aspects of the design brief. M. is so keen to share his (new) insight about the design process that he has to be asked to wait while the other members of the group finish writing their thoughts down before sharing them. He then says, 'I think I have solved a problem with myself through this course. My biggest problem with design projects was: you make something and then you make up why it is nice. That is what I always experienced, and usually I took five minutes <to make something up about it>, and in the movie <video footage> I really saw that what I always thought I make up is actually in the process, that's why it is so fast <i.e the five minutes he thought he was taking to make up a rationale for design decisions>, and nothing is made up afterwards. That was really my biggest problem with designing 'cos you just made something and its perfect because of that and that and that, and I would stand in front of people and think I hope no one sees that I have made it up 'cos it's not true and I am lying my ass (sic) off and I'm not because it's there.' When he is asked whether it has been the story-making or just looking at the video footage that has shown this up, he says, and the others all concur, that, ' when you are going to make a story out of it you have to look at the record of the design process critically and that's what makes the difference'.

P., who has less design experience than the rest of the group, also started the workshop with firm convictions about design teams. Her realisation concerns the richer potential for creative input when a team works effectively. Because she has less practical design experience than the others she is learning what they already appreciate, as J. puts it, 'that one plus one equals three, you can stimulate each other'. On the issue of self-awareness of the learning, P. is unambiguous, she has been less forthright in some discussions than she would have liked to be because she has felt that her skills in speaking English are less strong than the others' but when the group is asked to say what has changed, if anything, about their ideas about designing, she is keen to go first, and with great gusto and evident incredulity she says, 'So, I am very surprised, because now I trust in planning, … I cannot believe it - that I think now that … the next time that I design something .. more or less what you have to do is …<and then she elaborates on the value of dividing the work and using what others can contribute>'.

The remaining two students also contribute their new insights; these are refinements to what they thought before rather than radical shifts but their self-awareness of having changed the way they see designing in a team is equally strong.

5. Concluding discussion

There is no doubt among the student participants from both workshops that VALiD was a valuable experience, well-timed, catching them at the point of moving from formal education to full-time design practice. Although course credits were given for attending the workshops, they were elective studies. Thus, those who chose to take part already recognised themselves as ready for, and to some extent in need of, what the workshops claimed to offer namely, an opportunity to question their understanding of the design process.

It is difficult, empirically, to separate out the influences of individual workshop activities on the overall effects on the students' perceptions of designing. Setting the students the task of making a ten-minute video-story about the design process using footage from the two and a half hour design task certainly played a critical role in making viewing a replay of the event much more than a task-focussed, passive experience. Although there are other ways of making the viewing of video recordings an active and critical event as we have mentioned in section 2.4, the particular strength of a story-making agenda seems to be the freedom it leaves the viewers to set their own goals. This freedom is absolutely central to notions of self-organised learning (Johnson and McDonnell 1994); and thus to the personal meaning-making associated with the development of a deep understanding, that leads to a command of a discipline. The story maker constructs their own framework for making sense of events rather than being handed one to apply.

Planning the story as a group demands discussion about alternative ways of construing events; advocates of a particular way of making sense of events must describe and justify their proposals to the others. Making a case and seeing the ways others do this are both important mechanisms for deeper learning.

If we take a process-centred view of learning such as Kolb's (that learning is the process whereby knowledge is created through the transformation of expertise) we cannot measure what has been learned using outcome-centred metrics. Instead we have to create settings where learning is encouraged by confrontation among modes of learning, principally, using Kolb's terminology, between concrete experiencing of events and abstract conceptualisation. Making a video-story is very effective in moving the story maker from actor to observer and from specific involvement to detachment (Kolb op.cit.). It would be interesting to analyse the data from the VALiD workshop activities in terms of how much confrontation between modes of learning they promote. Better story-making workshops could perhaps be devised on the basis of such analysis.

Workshops like VALiD might be thought of as an impractical luxury for undergraduate design education. For instance, the number of participants in each workshop is small; an intensive two-week course might not fit easily alongside other courses in a degree programme structure. However, it should be clear from the description of VALiD we have given here that much might be achieved by making similar workshops available at strategic points in a designer's education.

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