

Developing meta-cognitive awareness of design process

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ABSTRACT

According to Lawson (2006), “One of the weaknesses of the traditional studio is that students, in paying too much attention to the end product of their labours, fail to reflect sufficiently on their process” (p.7). Within a design education context, lack of reflection can, it is argued here, lead to repetition of past mistakes due to an inability to recognise the interrelatedness and significance of the various stages of designing. So the starting premise here is that if students can develop more awareness of their process, they may be more able to identify both their strengths and weaknesses. If students can also relate their process to the learning outcomes then a cross-checking system may facilitate not only meta-cognition of process but also greater awareness of how process can be more effectively related to achieving the learning outcomes. So, explicit awareness, rather than tacit understanding can be achieved.

This study reports findings of the first cycle of an action research investigation into design student meta-cognition. It does this through discussing how the formal inclusion of a design process map can be used to assist illustration students develop meta-cognitive awareness of their approach to a design task in relation to the learning outcomes of an assignment. While there are various maps which describe the design process; *design procedure-problem analysis-design solution* (Edelson, 2002); *analysis-synthesis-appraisal-decision* (Markus/Mayer, 1969, 1970); *problem structuring, preliminary design, refinement and detailing* (Cross, 2001); *problem identification and definition, task planning and management, research and evaluation, ideation, idea selection and decision making, action and implementation, reflection in action, evaluation of process and progress* (Wilson 2002); Swann’s (2002) model *problem-analysis-synthesis-execution-production-evaluation* was chosen to broadly represent the various stages of designing.

INTRODUCTION: SETTING THE PROBLEM

Oxman (2001, p. 273), referring to how design has been taught in institutions over the centuries, uses the term “the third paradigm” to describe where design education should be headed. Referring to the atelier system as practised in L’ Ecole des Beaux Arts as the first paradigm, she outlines how the model developed in the eighteenth century can still be recognised today. In this model the studio

simulated the professional environment with the tutor as master setting the problem to be solved by the students. While this educational structure was teacher centred, it has not been totally replaced, with some design schools still retaining elements of the master-student relationship—with the tutor passing on his knowledge to the student. Oxman describes the second design education paradigm as that developed at the Bauhaus and the Russian State Higher Art and Technical Studios (VKHUTEMAS). Structured visual exercises which contained design principles to be learned was the basis of this model. Thus, visual literacy and problem solving expertise would be attained through the exploration of general design principles. However, says Oxman, while these two systems were rich and diverse, neither of them was concerned with the design process itself. Oxman continues by saying that both models (atelier and Bauhaus) concentrate on the design object rather than on the knowledge to be gained from the educational process. With recent knowledge of the cognitive processes being gained by cognitive psychologists, there is now a need for a third design education paradigm.

The third paradigm is the education of designerly thought processes in design reasoning and design strategies. This includes how designers think in various characteristic design domain problem types, in reasoning, in exploiting graphical representations, in employing multiple forms of reasoning in design strategies (Oxman, 2001, p. 273).

Norman (2000) also calls for the development of a third paradigm in design education where “making process rather than product [becomes] the logical emphasis for students’ education” (p.95). She goes on to say that students must learn to understand their modes of thinking and develop analysis skills which enable them to “explore creative options, plan and organise a potential solution” (ibid).

METHODOLOGY: ACTION RESEARCH

One of the characterising features of action research as a methodology is that it is used to actively address an identified problem. The tendency for some students to be product focused and unaware of process can be characterised as a problem. Therefore, action research was

considered to be an appropriate methodology for this study.

McNiff and Whitehead (2006) describe educational action research as a form of enquiry that enables practitioners to investigate, evaluate and improve their teaching through evidence based decision making (as opposed to ad hoc intuitive actions). Many writers, including Somekh (1995), Noffke (1997) and Gustavsen (2001) consider action research a bridge between theory and practice. As a practitioner who has long relied on tacit knowledge, action research appeals to me because it embraces the idea that practical knowledge can be used to help develop theoretical or explicit understanding and bring about improved learning and meaningful change in a studio situation. This is what Trigwell (2002) calls “pedagogic resonance” (p. 13). According to Cohen, Manion and Morrison (2005, p. 226) “Action research may be used in almost any setting where a problem involving people, tasks and procedures cries out for solution, or where some change of feature results in a more desirable outcome”. The identifying feature of action research is that it is incremental and iterative, based on a series of steps or cycles, namely: observe—reflect—act—modify (Lewin, 1943). These steps have also been described as plan—act—observe—reflect (Kemmis, 1991; Zuber-Skerritt, 1992). Gummesson (1991, p. 62) refers to these cyclical structures as a “hermeneutic spiral”, each turn building on knowledge gained from the preceding spiral. As with design, action research is an iterative, problem solving activity (Swann, 2002).

THE FIRST CYCLE

The setting for this first cycle was the illustration studio. The students involved were in their third year of study. The studio project was titled *What is Design Thinking?: An exploration into the cognitive processes of the design process*. Students were asked to create an image which addressed the question contained in the project title. As was pointed out in the assignment brief there is no single definition of design that everyone will agree with. Therefore students were asked to read up on the theoretical contexts surrounding the issue of what is design and what is design thinking. As a venue for their illustration work students were asked to design their image for the Design Research Society 2010 conference in Montreal. I invented the title “The Thinking Designer” to provide some context for the student work. The key learning activities and outcomes focused on investigating and critically evaluating the theoretical backdrop of design thinking; the development of concepts which demonstrated theoretical understanding of design thinking; and the consolidation of concepts into a rendered piece of communication design.

THE LEARNING STRUCTURE

Learners are, to use Mayer’s (1996, p. 364) constructivist definition, “sense makers”. We can therefore position this to mean that, if learners are sense makers, then learning strategies are forms of meta-cognitive process used when the learner “actively tries to build a coherent and

meaningful representation of the presented material” (ibid). During the assignment students charted their progress through the use of a provided format which broke up the assignment by listing the learning outcomes in relation to Swann’s six design stages. The sheet was described as a ‘process diary’. Students were asked to think in terms of *focus moments* to recognise that at any given stage there will be focus on, say analysis, but that other stages and activities relevant to process will be regularly overlapping. By connecting their work to the stages of design and also cross-checking such activities to the stated learning outcomes, it was hoped that students would become more aware of the looping, interrelated stages of designing.

Figure 1 shows Swann’s (2002) design process model in relation to how students calibrated their activities during the assignment. The activity was voluntary but most students used the process diary and wrote various comments on it.

FigureF

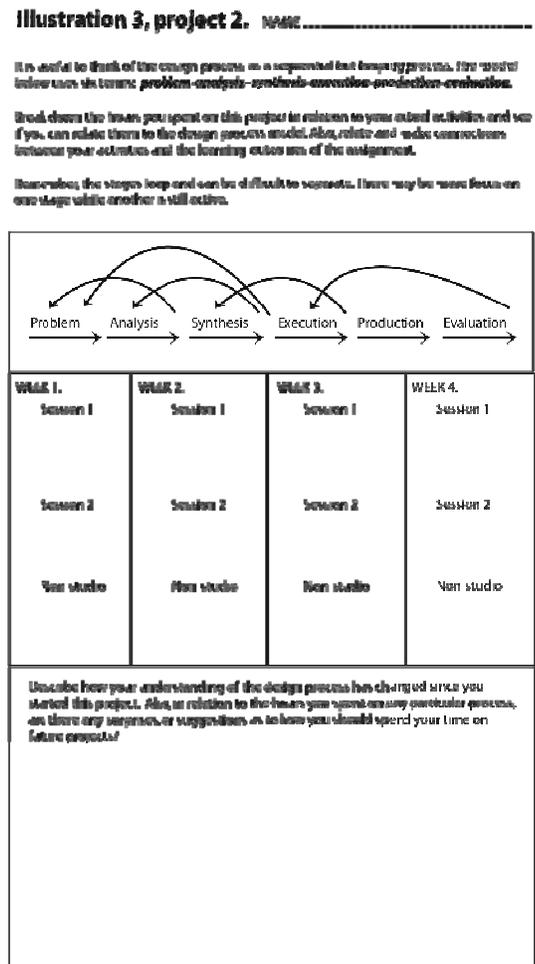


Figure 1. Swann’s (2002) Design process model.

PATTERNS IN THE DATA

In relation to student comments, one of the most recurring revelations for students was that the design process is a loop and that students were now more aware of their process. The following are some written student comments in relation to that.

I think that understanding the design process is not just a linear process, but as a process that flows between stages is incredibly helpful.

Have looked at how I flip back and forwards through the design process throughout a project. I now understand my creative process more and how I tackle a problem.

I found this useful to remind me to re-analyse my ideas in relation to the problem. This has helped my understanding of the design process.

Some students said they were more willing to re-visit earlier stages of their design process. This might seem rather surprising, but studies have shown that some design students have misconceptions as to what constitutes a good design process. Newstetter and McCracken (2001) carried out a study which looked at misconceptions among first year design students as to what constitutes design activity. Their three year study identified five features of novice design activity which differ from expert (design professional) approaches.

1. *Ideation without substance* - Students believe design is coming up with good ideas. Design does of course include ideation but designers also concern themselves with the practical realisation of ideas and evaluate them based on informed decision making and analysis
2. *Design arrogance* - Students do not place their designs in the context of the environment in which the design will reside. They arrogantly ignore the constraints of the user. They tend to design for themselves
3. *Design shutdown* - Students focus on single solutions to problems once beyond the ideation stage. Once they have an idea they stop considering alternatives and focus their energy on the one solution regardless of its feasibility
4. *Design jumps* - Students will often operate at only two levels of abstraction. The highest level of general idea (function) and the lowest level of the components of the product (structural). They do not move between these spaces in a formal manner, nor do they consider

the implications of the giant leaps they are taking between the two levels

5. *Design routinisation* - Students act as though designing in a serial/linear process. They deal with design problems without revisiting previous decisions and evaluating alternatives. It is non iterative.

Figure 2. Five features of novice designer activity. Newstetter & McCracken (2001, p. 67-68).

I too have recognised these misconceptions or approaches to designing in my students. The formal approach taken in class with my students encouraged many of them to re-visit their earlier stages, avoiding design shutdown, design jumps and design routinisation. Students were much more aware of their processes. The following student comments seem to support this:

I wouldn't have kept going back and re-thinking things if I wasn't aware of the steps.

I found myself willing to continue going back to analysis instead of committing to the synthesis stage too early.

I think that my willingness to re-analyse for this project was really helpful, and I hope to carry this creative process through to future projects.

I found this useful to remind me to re-analyse my ideas in relation to the problem.

THE LEARNING OUTCOMES

The key learning activities and outcomes focused on (1.) investigating and critically evaluating the theoretical backdrop of design thinking; (2.) the development of concepts which demonstrated theoretical understanding of design thinking; (3.) the consolidation of concepts into a rendered piece of communication design.

On completion of the project students presented their work and it was critiqued by their peers and by myself also. A class discussion at the end revolved around talking about what was learned. The process diary sheets were looked at and we were able to see that as each week progressed student focus followed a linear path from problem to production but with a clear looping element in each diary as well. This was a revelation for some students who said that they had never really thought about design in this way before. However, later analysis of student workbooks showed that some students were still very much product focused with a heavy leaning towards the final idea. Some

workbooks also showed gaps between stages or insufficient analysis or synthesis of gathered research material. So, this may be related to *surface* as opposed to *deep* approaches to learning.

Drew, Bailey and Shreeve (2002) conducted a study on fashion students' approaches to a design project. The theoretical underpinnings relating to learning were the *deep* and *surface* model (Marton and Saljo, 1976) and *deep*, *surface*, *strategic* (Entwistle, 1987). As they were seeking understanding of variation in how students experienced a design task, and not setting out to change students' approaches to a design task, they found phenomenographic research the most appropriate methodology. Drew et al.'s study surveyed 21 students about a project that had recently been completed and assessed. The researchers identified four approaches to learning (Figure 3.).

<p>Approach A Students adopt a product-focused strategy with the intention to demonstrate technical competence.</p>	<p>Approach B Students adopt a product-focused strategy with the intention to develop the design process.</p>
<p>Approach C Students adopt a process-focused strategy with the intention to develop the design process.</p>	<p>Approach D Students adopt a concept-focused strategy with the intention to develop own conceptions.</p>

Figure 3. Drew et al. Four approaches to learning (2002, pp.187-18).

Each student was interviewed and asked to recount their experience of the project. By looking for variation and determining patterns of responses, the researchers were able to create the four categories. The following is a summary of their findings. Drew et al. found that with approach A students, common traits were a desire to 'get it right', to produce a product or technique and to do it as they are instructed. These students also relied a lot on the tutor to show them and tell them how to do things. Approach A students tended to think of the design process as being one of applying techniques and procedures. Information is derived to identify what can be copied and reproduced. With approach B students, the focus was also on the production of the artefact and the acquiring of techniques, but these students also adopted strategies for experimentation with the design process. Approach C students were more interested in processes, trial and error experimentation. They used their design strategies to develop ideas and were less product focused. They also preferred to interact with other students as a way of further extending creative possibilities. They wanted to develop new ways of manipulating materials and techniques. Students who adopted approach D also used experimental approaches. Ideas and visual concepts were developed by

using research to its full advantage. Research helped them make connections and develop a wider view of things. Students were engrossed in the development of concept, not the application of technique. Interaction with tutors was done mainly to develop critical and conceptual thinking (Drew et al., 2002, p. 186-194).

One thing which can be drawn out of Drew et al.'s study is how it in some way suggests that students whose approach was oriented towards surface learning (approach A and B) were pre-occupied with making product, while those oriented towards deep learning (approach C and D) were more focused on process and concept. As I have noted a product oriented approach in many of my own students, this study suggests that design teaching has, perhaps as a consequence of tradition, been encouraging a surface approach to learning with many teacher and student conceptions of design revolving around making artefacts, rather than the process of design, i.e., the thinking process. This study also suggests that students with a more resolved understanding of the design process value all the various stages of design enquiry, not just that of artefact construction. Drew et al.'s study also demonstrated for me that seminal studies such as that carried out by Martin and Saljo (1976), while being based on students' approach to a text-based study, can be adapted to suit an image-based study.

KEY FINDING OF CYCLE ONE

Comments by my students, both verbally and those contained in written rationales, suggest that the key success in this study was that students individually, had developed more awareness of their personal design process. The study didn't necessarily lead to better designing, but it did help some students to be more aware of weaknesses in their design approach.

I have become far more aware of where I stand in the design process in terms of my strengths and weaknesses

I often neglect or leave out steps. Also I usually forget to go back (i.e research)

We have always been told to do research, but I now see it as analysis and how it links to everything else, I don't think of it as just something we have to do

I've learnt to keep going back and visiting each process, just because you're near the end of the process, doesn't mean you can't change it if it isn't working

The final designs consolidated and concluded what was done in class. I have included a few examples. As regards answering the question 'What is design thinking?', students had some interesting insights.

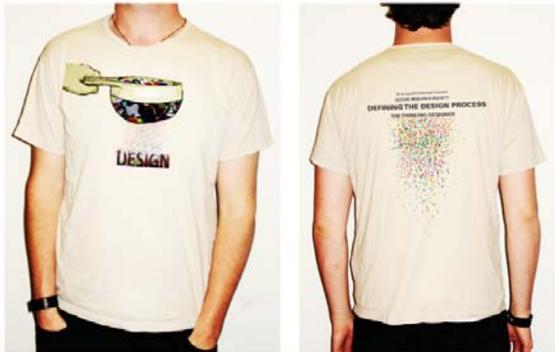
For me it is a process of gathering and filtering information and ideas, and bringing aspects together to create, clarify (a design). There is never one answer

Squeezing all possible angles out of a problem through research and creative thinking, narrowing down and reflecting simultaneously to achieve a goal

A process of creative problem solving, build up of ideas, issues, trial and error and research used to form a solution

CONCLUSION

Action research, like design, is iterative, incremental and reflective. This study did address Lawson's (2006) lament that design students are too fixated on production of design rather than the processes of design. As a first cycle the study did make some progress towards helping students become more aware of their design process and more aware of the relationship between different stages involved in designing. It didn't necessarily stop some students from focusing on the final artefact or taking shortcuts, but the study did encourage reflection. As regards a follow up second cycle, I believe more needs to be done to encourage students to relate their activities to the learning outcomes of an assignment.



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