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Exposing and improving the metacognition of designing through practical structured workshops

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Abstract
This paper is a result of two one week workshops, delivered at the Departement van ProductOntwikkeling (Product Development) de Hogeschool, Antwerp, Belgium. The workshops were delivered to first year undergraduates, on the 5 year degree Product Development course. They consisted of 4 one day design projects around the context of ‘children and food’ in the first week and ‘children and play’ in the second. Each project was different in focus and complexity, and the students’ means of operating was deliberately constrained in different ways by each of the projects. The pattern of each day was designed so as to both ‘fast forward’ the students’ working and to focus their attention onto different aspects of their designing. Details of the students’ reactions at the start and end of the week were collected as a record of the change in their understanding of their designing. The work confirms that it was possible to increase a group of design students’ awareness of their own way of working: first in terms of their means of expression using words, pictures and 3 dimensional modelling, and second of the process of their designing, using a structured project work approach.

The setting
The major focus of the Departement van ProductOntwikkeling (Product Development) de Hogeschool, Antwerp, Belgium, is to teach a course in product design. This course has been running for 27 years. An aspect of the school year has always been International Weeks, when guest designers and lecturers have been invited to run a course of study or a project. It was such a time which gave the opportunity for the two groups of first year students to spend one week on this workshop. The activity in this paper was therefore both research and teaching. It can be defined within the limits of ‘action research’, in that aspects of both the validity and reliability of the work were specific to the situation.

The context
Designing has become an umbrella term which can contain all kinds of mental and physical activities. Rather like the word ‘farming’ where one person can spend their lives inside a building rearing animals whereas another may spend their time gathering crops, ‘designing’ includes such activities as creating, evaluating, analysing, making, and testing. Simon⁴, in his definition of design as the ‘sciences of the artificial’, places the activity in the imagination. Thinking, within the context of a future vision and with a focus on outcomes, would seem to have become a working definition. As an activity that takes place within the head of the designer, it is difficult to separate it from thinking. All dialogue with ideas has to be by expressing those ideas outside the head⁴.

Attempts to evolve a ‘system’ for designing that is universal, have been useful in terms of developing management and organisational strategies, but of little worth in improving the designing capability of the individual. If the ability to design is to be improved, it can only be by enhancing the individual’s own view of the way that they do it - by them becoming metacognitive about their own designing.

Designing as a complex activity
Through a series of exploratory interviews with professional designers, it emerged that they each have had a strong personal viewpoint of their role as a designer. Their criteria may be visual, moral, philosophical, economic or spiritual, but they can all say why they are doing what they do. This idea of personal viewpoint is supported by Buchanan⁴ through a concept he refers to as ‘placement’. The ability to see things from where you are, but also from other positions
is described by Schön as being one of the skills of the reflective practitioner, where the ability to change the viewpoint of the work by seeing it ‘in a different (conceptual) light’ is a sign of the skilled professional. Whilst designers are often not overtly concerned with methodology, the ability to shift viewpoint, a technique often called lateral thinking, is valued as a procedural and perceptual skill aimed at developing the new, the unique, or the different answer. The work of Kimbell et al. when assessing excellence in performance in design and technology, defined this as being fluent with a range of imaging and expressing techniques.

if you (students tested) can integrate active and reflective ability with appraisal you are most likely to score high holistically.

Excellence can be defined as the fluency with which ideas are developed and modelled using a range of the two capabilities; ways of expressing ideas and ways of viewing the design situation. A high capability designer can operate and switch fluently between these abilities, much as a juggler keeping several balls in the air simultaneously.

Following the poster presentation at IDATER 96 entitled ‘If the only tool you have is a hammer then all your problems look like nails’, where the attempt was to apply existing measuring instruments (Cognitive Style Analysis, Design and Technological Capability, Mapping learning and designing intentions) to students’ designing to describe their ways of working, came the realisation that although it made the work more transparent to the researcher, it made little or no difference to the students' views of their own processes. The students seemed to agree with what had been established in interviews with practising designers, that they are less concerned with methodology than with the outcome. Work by Durling, D., Cross, N. and Johnson, J., on designers’ personality type, using Myers Briggs Personality Type Indicator, supported by the work of Lawson, gave insights into the ways that designers prefer to work. (See figure 1)

![Figure 1 Myers Briggs type indicator relating occupational type to personality](image)

adapted from:
Durling, D., Cross, N. and Johnson, J. (1996) Personality and learning preferences of students in design related disciplines

Figure 1 Myers Briggs type indicator relating occupational type to personality
From this work designers will in general be midway between feeling and thinking and prefer intuition to sensing or logic. In order for advice to be effective at a metacognitive level it should be capable of being accomplished in the means most suitable to the individual. For example, when you tell the doctor that you are not well, you have a perception of the kind of answer that you require in order to be ‘made well’. If the doctor’s answer is not of the same genre, then you are less likely to have faith in their diagnosis, or in the efficacy of the prescribed cure. Using the characteristics in the Myers Briggs Type Indicator would suggest that there is a continuum between diagnostic testing on one extreme and experiential counselling on the other. Durling et al.10 suggest that Engineers and Managers would prefer diagnostic testing whereas designers would prefer intuition and experience. In order to appeal to design students, (in that Durling has found that they are similar to designers), they should themselves be included in the research by getting them to analyse their own designing, noting their reactions to their ways of working, and making intuitive diagnosis as to their preferences. Raising their awareness may therefore be managed through counselling structures in contrast to a more analytical approach of them being externally analysed and their designing style diagnosed.

Designing the workshops

The workshops were designed to give hands on experience of a variety of ways of both doing the work, and looking at the work as it was being done.

There were two distinct elements that affected the design of the workshops. First, in the previous work7 using the test for cognitive style8, the elements of Imager and Visualiser within the testing failed to describe all of the capabilities the designers brought to bear on their work. There seemed to be other areas such as ‘talker’ and ‘3 dimensionaliser’, that were manifested by the student designers but not accessed by the test. Gardner12 identified the following multiple intelligences: musical; linguistic; logical/mathematica/scientific; spatial visual; kinesthetic; interpersonal intelligence; intrapersonal intelligence. Using this notion developed by Gardener, three aspects were chosen: words; pictures; and 3D modelling. These correspond to Gardner’s intelligences of linguistic, spatial/visual and kinesthetic (inventor). These three were chosen as being representative methods that designers use to express their ideas. This is not to say that other means of expression are unimportant, but were not focussed in this study. Second, the earlier work6 indicated that an individual’s perception of the problem shapes their ability to solve it. (If the only tool you have is a hammer then all your problems look like nails.) Kolb13, and Rogers and Clare14 support the idea of action and reflection having a powerful influence on learning, looking back on what has been done and saying what and why. In addition Rosenberg and Booth15 advocate that describing ‘what is now’, and projecting ‘what will be’ are important concepts in developing designing capability. Schön4 and Buchanan3, see the ability to express problems in a fresh way as being the capabilities of the reflective practitioner and designer.

As a result of the above considerations the following two factors were thought to be important:

• The means by which the designing is expressed using words, pictures and 3D dimensional modelling.
• The ways of evaluating and progressing the designing using reflection - of what has happened, description - of what is now, projection - of what may happen and positioning - looking from a new conceptual viewpoint.

The plan was to provide a series of design activities within which the skills of using words, pictures and 3D, and experiences of reflecting, describing, projecting and positioning would be presented to the students in such a way that they could judge intuitively10 the worth to themselves.

Figure 2 shows how the workshops were organised. It shows how each of the 4 projects within the two contexts were chosen in terms of their breadth of possible activity and how each of the projects was organised in relation to the paperwork.
### Project Structure

The format for the projects was a modified version of the ‘modelling tests’ (Kimbell et al. 1991), but used not as an assessment tool but as a means of structuring the projects. The ability of this structure to ‘fast forward’ designing activities, yet not direct the type of activity, were the main reasons for its choice. A limited time was allowed for each stage of the process, at which point the students were told to move on to the next stage.

The paperwork was structured as follows:
1. Overview
2. Overall Evaluation sheet
3. Project structure plus evaluations of words, pictures and 3D
4. Project structure and describing, reflecting, projecting and re-positioning *3 & 4 were repeated for each project. (See Figure 3)

### Focus of the paper work

The purpose of all but the initial and final evaluations was to focus students reflections in order to prompt an examination of their own ways of working. The recording sheets were designed to illicit responses and thus a level of metacognitive awareness in the following areas:
- The use of words, pictures and 3D modelling as means of expressing designing.
- The kind of activity that was taking place at each of the stages of the project. Was it reflective, descriptive, projective or positional?
- Within the group discussions, to identify the context of the discussions. Were they aesthetic or technical? Did they focus on peoples needs or objects and their specification? Were the comments constructive or obstructive in their nature?

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**Week 1**

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<thead>
<tr>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
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<tbody>
<tr>
<td>Introductions</td>
<td>Project 2  Children feeding themselves for the first time</td>
<td>Project 3 Food for thought for the 3 year old</td>
<td>Project 4 Children eating with the family</td>
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<tr>
<td>Project 1 Feeding Children on the move</td>
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<td>End of day presentations and final workshop evaluation</td>
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<tr>
<td>Input- introduction to the paperwork</td>
<td>Input- designing style and personality</td>
<td>Input- wholist analyst - big pictures, small steps.</td>
<td>End of day presentations and briefing</td>
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<td>End of day presentations and briefing for the next day</td>
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<td>End of day presentations and briefing</td>
<td>End of day presentations and final workshop evaluation</td>
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**Week 2**

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<th>Monday</th>
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<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
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</thead>
<tbody>
<tr>
<td>Introductions</td>
<td>Project 2  3D toy - motor skills and collaboration</td>
<td>Project 3 Starting school</td>
<td>Project 4 Teaching children about designing</td>
<td></td>
</tr>
<tr>
<td>Project 1 Entertaining journeys</td>
<td></td>
<td></td>
<td></td>
<td>End of day presentations and final workshop evaluation</td>
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<tr>
<td>Input- introduction to the paperwork</td>
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**Figure 2** The structure and content of the workshops
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**Project 1**
Was quite general and provided time for the students to become familiar with the paperwork.

**Project 2**
Was very focussed. Students in groups of three could only use one of the methods of expressing their ideas (tools) at each stage. They then had to rotate the tools for the following stage. For example a person who used drawing to put down their first ideas (stage 1) would then have to evaluate those ideas in 3D (stage 2).

**Project 3**
Was quite focussed. The students were allowed to chose their preferred means of expression at each stage.

**Project 4** was very general. Students could work as they wished with no time or presentation constraints, but with interviews twice each day with the tutor.

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Figure 3 Overviews of projects

- The end of project evaluations to allow a focussed and critical viewing of the work of the others in the group.

**Overall procedures**

Serious attention was given to the languages used. It is fundamental in any study which involves increasing self knowledge that the students are encouraged to use their first language, in this case Flemish, rather than have to translate it for the benefit of the observer. For this reason all discussions and presentations were conducted in Flemish. Instructions, although in English, allowed translation and discussions by the small working groups. There was an attempt when in discussion with students about their work to ask questions rather than give directions and to be encouraging and supportive about their work, rather than being judgmental.

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Figure 4
Theoretical inputs throughout the week

Because the week was a combination of research and project work, at certain points in each week there were theoretical inputs to explain the reasoning behind the workshops. The inputs were on the theoretical basis behind the design of the workshop, including designing style and its relationship to personality, wholists and analysts and the relation of thinking in ‘small steps’ or ‘big pictures’ to designing.

Results

The aim of this work was to increase the level of metacognition of the individual students designing and as such the overall evaluations were the most critical in providing evidence of student progress. Even with these, one has to ask the question how do you assess whether metacognitive progress has been made or not? The content of the translated text was examined to assess the change of viewpoint, if any, from the first statement, made at the start of the week, to the second, made at the end of the week. Also, whether this change, as stated, related to means of expression, or the process of working. Changes of viewpoint could be expressed either positively or negatively, for example a comment that rejected what was being presented but gave reasons why, could be said to have been the student positively choosing an alternative. Of the 51 students only 2 said that the workshops had been of no use to them. 20 made comments on the means of expressing their designing, 22 commented on their procedures in designing and only 2 students made reference to both of these. (See Figure 5)

Several students noted the discovery that they used discussion as one of their preferred skills. Many of them stated that they now felt more comfortable in the use of 3D modelling as a way of designing. Within the views of the process, there was no clear reinforcement of my theory that the terms ‘reflecting, describing, projecting and repositioning’ were important to the metacognitive process. Several of the comments referred to designing styles that had been identified (big pictures or small steps) but none of the students referred to the earlier notions of reflection, description, projection or repositioning.

Conclusions

This work shows that by using design projects as the medium, that it was possible to increase students awareness of the possibilities and their own preferences for designing, through an analysis of their means of representing their ideas and progressing their designs. It shows no proof that by using the methodology adopted, that the ideas of reflection, description, projection and repositioning were of any relevance to the metacognition of their designing, but that the activities did prompt comment on their ways of working by 22 of the students. Follow up research with

<table>
<thead>
<tr>
<th>Comments about words - pictures - 3D</th>
<th>Comments about working procedure</th>
<th>Positive but general comments</th>
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<tbody>
<tr>
<td>20</td>
<td>2</td>
<td>22</td>
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Figure 5  A summary of student comments by analysing the difference between the comments made at the beginning and end of the workshop

Student total 51

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this same group of students may reveal how influential this work has been in their subsequent design projects, or how transferable this approach could be to other groups in other situations.

Further research in this area is in two directions. First, following this work with design students with an experiential and intuitive realm, to find a better way of describing the procedures of designing that can prove more acceptable as a means to self learning. Second, within the realm of logical and objective personality types, with say engineers, to explore practical means to assessment and diagnosis of designing, and to test the effectiveness of the approach in making transparent their designing.

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