

THE INFLUENCE OF SELF-REFLECTIVE DIARIES ON STUDENTS' DESIGN PROCESSES

Maral Babapour¹, Ulrike Rahe¹ and Owain Pedgley²

¹Division Design & Human Factors, Department of Product and Production Development, Chalmers University of Technology, Gothenburg, Sweden; maral@chalmers.se, ulrike.rahe@chalmers.se

²Department of Industrial Design, Middle East Technical University, Ankara, Turkey; pedgley@metu.edu.tr

Keywords: Form Design Process, Educational Self-Reflections, Reflection-On-Action, Diary Studies

ABSTRACT:

Earlier phases of design projects are always followed by the activities of analysis, synthesis and evaluation that are the outstanding commonalities shared between design process models. Designers continuously organise and reduce large amounts of generated data in order to find cohesion and clarity and gain a holistic understanding of the design space. The present research considers a specific way to facilitate the design processes of students. It elaborates on using diaries as an educational method for documenting self-reflections, which in turn aid students' product form creation processes. Placing emphasis on reflection allows design students to (i) assess their activities and self-criticise the progress and content of their design projects, (ii) better plan and organize their project activities, and (iii) better communicate with other stakeholders in the product development process, by providing an opportunity to articulate what they have done.

INTRODUCTION

Design is defined as an iterative task requiring creative and inventive thinking, which includes stages of divergent and convergent thinking (Cross, 2011; Lawson, 2006; Schön, 1991). The importance of promoting innovative thinking in design education and nurturing students' creative processes has been repeatedly highlighted and emphasized by scholars (Hope, 2009; Loewy, 2008; Wong & Siu, 2011). In order to fully foster creative processes in design education, a deep understanding of those processes is required. Understanding the structure and content of design processes has always been considered a challenge within the design research community (Blessing & Chakrabarti, 2009; Cross, 2011). Different research methods and

approaches have been used in empirical studies to shed light on design activities for example, interviews (Lawson, 1994), protocol studies (Cross, Christiaans, & Dorst, 1996) and observations (Bucciarelli, 1994; Schön, 1991).

Although it is argued that designers themselves are the only authentic source for finding information about underlying thoughts and decisions when designing (Pedgley, 1997), usually designers fail to explain what they do when asked in interviews, or they provide unconvincing descriptions since design problem solving situations are complex, unclear and puzzling (Cross, 2011; Lawson, 2006; Schön, 1991).

To portray the complex processes of design, different models and maps have been proposed over the years (Cross, 2000; Lawson, 2006; Roozenburg & Eekels, 1995; Ulrich & Eppinger, 2008). The activities of analysis, synthesis and evaluation are the outstanding commonalities shared between different design process models, through which designers organize and reduce their design problem and solution spaces towards cohesive, clear and well-defined design proposals. However, what have generally been missing are complementary long-term studies of design activity (i.e. lasting many weeks or months), which can 'flesh out' in much greater detail how a designer progresses from a brief to a proposal. In other words, studies that reveal the precise path of design thinking and design decisions made during a project. Results of such studies can have two key benefits: (i) for design researchers, who wish to characterize some aspect of what it is a designer does, and (ii) for designers, who may adjust their own design practices according to what they have learnt.

In this present research, we were occupied with point (ii) – the uncovering and communication of design practices as an educational tool, to aid students' product form creation processes. We concerned ourselves with techniques for self-reflection during designing, not only to benefit designers' own project planning and organization activities but also to facilitate communication with other stakeholders in the product development process. More specifically, this paper elaborates on the use of design diaries for collecting self-reflections during a course in Advanced Form Design (7,5 ECTS, master level), involving a total of 50 students over a period of three

years. The aim is to focus on the influence of self-generated diaries on students' ability to understand, articulate, and communicate their individual form design processes.

LEARNING PROCESSES AND DESIGN PROCESSES

In the cognitive domain, educational objectives are classified in six major categories according to Bloom's taxonomy of learning: knowledge, comprehension, application, analysis, synthesis and evaluation (Krathwohl, 2002). Obvious similarities exist between these educational objectives and the commonalities among the design process models mentioned in the Introduction. This presents the intriguing situation that the progression through a design process is analogous to the phases of learning that are encountered more broadly. As is often recalled, designing progresses as a learning-by-doing activity.

During a lengthy design project, a large amount of data is generated which takes many forms: gathered photos, video, transcripts, magazines, and other material related to project contexts, as well as externalized design ideas in the form of sketches, annotations, CAD models etc. The presence of such a mass of externalized sources is because it is usually too much of a cognitive load for a designer to hold emerging design criteria and ideas in attentive memory at any one time. The most common approaches for organizing this 'design data' are digital folders, sketchbooks, big boards and large spreads of sticky notes, each of which help the designer towards a holistic understanding of their design situation. However, these methods are quite time consuming, and limited in different ways; (i) physical limitations imposed by the size of the boards, sketchbooks and laptops or desktops, (ii) digital limitations imposed by popular software tools and operating systems (Kolko, 2010).

It can therefore be fruitful to consider ways in which students might be able to self-criticise the progress and content of their design projects, without the need for time-consuming organization and analysis of the disparate array of 'design data' that they have generated. Such a method would ideally encourage designers to enter a period of reflection to assess their activities

(Pedgley, 1999). The process of reflection-on-action described by Schön (1991) presents a way in which practitioners (in our case designers) can draw upon certain routines, to build theories and responses to their work against a defined context or set of criteria (Smith, 2001). It can further provide an opportunity for designers to articulate and communicate what they have done, rather than just doing it and moving on to the next period of work leaving little or no trace of their design rationale.

USING DESIGN DIARIES AS REFLECTIVE TOOLS

Diaries can be used as a data collection tool, for logging activities undertaken by participants in a research study over a certain period of time in chronological order (Rieman, 1993; Zimmerman & Wieder, 1977). They have been predominantly used in social sciences for gathering ethnographic data, and psychology for investigating autobiographical memory (Koriat, Goldsmith, & Pansky, 2000; Robinson-Riegler & Robinson-Riegler, 2009). Diaries have even gained popularity in the human-computer interaction domain and more recently in the engineering design domain (Wild, Mc Mahon, Darlington, Culley, & Liu, 2009). However, diaries have not yet been extensively applied in the study of design thinking, design decision-making or design processes (Pedgley, 2007). Formats of diary studies vary considerably in terms of structure, complexity and layout, each of which can influence the data generated and hence the kinds of outcomes from a research study (Hyldegård, 2006; Pedgley, 2007). Diaries also vary according to the media in which they are prepared, such as paper- or electronic-based (Wild et al., 2009). The common point in design research utilizing diaries is that the diary data serves as documentary evidence of the progression of a design project or task, collected in a manner that is more comprehensive and rigorous than retrospective interviews or personal recollections some time after completion. Only highly conscientious designers accompany their everyday designing with some kind of log of reasoning or diary (Jones, 1992); therefore in almost all cases, diaries are requested from research participants (designers) as an additional layer of work.

In one of the most comprehensive examples, Pedgley (2007, 1999) deployed a diary of designing – of his own creative practice – as a research

'instrument', aiming to meticulously capture the trail of design activity during a long-term design project. Primarily the data sought was factual, regarding the consideration and selection of materials and manufacturing. But it soon became apparent during the generation of the diary that it caused an unintended but positive effect on the diarist. The process of reflection-on-action turned the diarist into a self-ethnographer, leading to diary entries that were also critical and analytical in character, rather than just factual. This, in turn, directed the diarist into completing a supplemental level of work: regular project appraisals and evaluations that were qualitatively different to the reflection-in-action (Schön, 1991) that occurs expectedly whilst engaged in designing or design thinking. In other words, the resultant personal effect of writing a daily diary is a self-critical sensitivity to one's progress and actions during a design project.

Pedgley found that assuming the role of a diarist eased the grasping and comprehension of design issues, thereby aiding future decision-making: a reflexive phenomenon that had been alerted to by Schön & Wiggins (1992). In this way, we may say that diaries draw attention to the diarist's past (designing that has been done), present (designing that is currently being done) and future (designing that is intended to be done). With these observations as a basis, it is possible to hypothesize educational benefits in the training of design students through their creation of personal design diaries.

DIARIES BY DESIGN STUDENTS: EARLY EXPERIENCES

Although Pedgley's diary of designing was developed specifically for the capture and analysis of own design activity, initial evaluations of the success of its use by other people were made during his doctoral studies (1999), based on diaries of two finalist industrial design undergraduates, working to the same design brief, who were asked to document their self-reflections to accompany their project work. A briefing session and written instructions were provided to the students to facilitate the diary-writing process, whilst a debriefing session was held on completion of the diary to elaborate on any unclear diary entries and to review the experience of being a diarist.

Pedgley found that using his triadic format of diary (Pedgley, 2007) as a tool for capturing other people's design activity, albeit from a rather exploratory and limited study, was fraught with difficulties: students' lack of motivation, time, priority or incentive were the main reasons for a scarcity of diary entries. Additionally, students mentioned that jumping to-and-from simultaneous design projects made it difficult to isolate design thinking for one particular project. The other more general point is that a tacit dimension in design decision-making is often present (Polanyi, 1983) – it can be inherently difficult to pinpoint design rationale in words. Further, the students reported that despite memorizing the diary instructions, they still had difficulty deciding what to write. This problem is essentially related to the necessity of the diarist to progress from a novice at the start of the study to an expert at the end. Pedgley's diary studies emphasized that the extensive use of open-ended or free-text diary entries gives opportunity for rich insights and varied styles of reporting, but in allowing such formats for the study of other people's designing, the researcher "relinquishes all control of the actual data collection" (Gutherson & Ashton, 2000).

THE CHALMERS UNIVERSITY DIARY STUDY

It was clear that some re-thinking and re-formatting was necessary to overcome the pitfalls of using diary methods to study other people's (in our case, students') design processes. Applied to a course in Advanced Form Design (two subsequent courses with 7,5 ECTS each at Master's level) over a period of three years, the use of design diaries for collecting self-reflections was constantly improved (Babapour, Rehammar, & Rahe, 2012). The improvements were intended to overcome common barriers: (i) the demanding discipline of daily recording, that no one would willingly do (Brett, 1987) – in response, diaries were submitted as part of students' course assessment and administered solely as an accessible digital document; (ii) the inexperience and/or capacity to write a diary – in response, students were provided with a template for structured diary writing, both to direct their focus and facilitate the diary documentation; (iii) the difficulties in maintaining diary entries – in response, formal check-ups were made during weekly supervision meetings; (iv) the problem of uncovering true and comprehensive accounts of design rationale – in response, students' design

rationale was probed using multiple data collection methods with a chance to expose any tacit dimensions; and (v) the recall effects caused by delays in writing diary entries – in response frequent and regular submission deadlines were set.

ADVANCED FORM DESIGN COURSE I AND II

The primary goal of the Advanced Form Design courses is to provide students with a superior understanding of product form creation. Since 2010, an additional aim of these courses has been to provide students with an opportunity to document their self-reflections within 'form generation diaries', based on the principles outlined in this paper. In the courses, students undertake seven-week form design projects, working roughly 20 hours per week. The distribution and characteristics of the students¹ who were registered for the Advanced Form Design II course – and who became the participants for this research study – are presented in Table 1.

Table 1 - Distribution and characteristics of Advanced Form Design II students.

Empirical Study	Academic year	Students	Gender		Age
			Men	Women	
Empirical Study 1	2009/2010	24	17	7	22-29
Empirical Study 2	2010/2011	11	5	6	21-29
Empirical Study 3	2011/2012	15	10	5	24-27

The students were encouraged to form groups of two or three for conducting their design projects. For project completion, the students were expected to turn an innovative formal idea into a product design concept with a high level of novelty, aesthetic detail, functionality and performance.

¹ Thirty students had a bachelor degree in Industrial Design Engineering from Chalmers. The twenty remaining students were exchange students with similar backgrounds.

STUDENTS' FORM GENERATION DIARIES

As a first step for understanding form design processes, the students were asked to focus on documenting their form generation activities, to seek the underlying motivations behind the decisions made during the design process and to record their retrospective reflections on their form generation activities. These documentations included self-reflective comments on the steps, decisions, use of methods and tools in addition to motivations and barriers during the form design project. In order to track the chronology of each student's process, it was emphasized to participants that they should log their activities on a regular basis. The diaries were uploaded to the course homepage.

Additionally, documentation of the visual outcomes of students' form creation processes was required. These could include scribbles, pictures, CAD-renderings and any other form of visual information essential for understanding the creative form generation process. The participants were especially encouraged to refer to their visual design outcomes within their diaries.

DIARY ANALYSIS

A thematic analysis of the diary data was carried out based on the qualitative data analysis approach suggested by e.g. Miles and Huberman (1994), consisting of three phases: (i) data reduction, (ii) data display, and (iii) conclusion drawing and verification. The initial phase involved searching for themes, summarizing, coding, categorizing, and registering excerpts from the diary data alongside the visual outcomes, using NVivo qualitative data analysis software. Finally, conclusions were drawn by interpreting the emerging meanings within patterns and by identifying (ir)regularities in the data and possible explanations. The conclusions were verified by a final check of the diary contents and by searching for corresponding results from other design research studies.

RESULTS AND EDUCATIONAL BENEFITS

Each diary stretched over a seven-week design project. Table 2 shows the total number and length of the submitted diaries and supplemental documents.

Table 2 – Total number and length of diary submissions.

Empirical Study	Academic year	Supplementary documents per student	Diary length (pages)
Empirical Study 1	2009/2010	1	7-34
Empirical Study 2	2010/2011	7	14-44
Empirical Study 3	2011/2012	11-21	15-64

Students' elaborations on their form design processes indicate that: (i) form generation diaries were received as a facilitator to mature the abilities to recognize, interpret, differentiate, evaluate and criticise creative findings, as exemplified in Figure 1; (ii) use of form generation diaries led to the development of a taxonomy / terminology for discussing the form generation process and arguments for or against certain approaches and preferences.

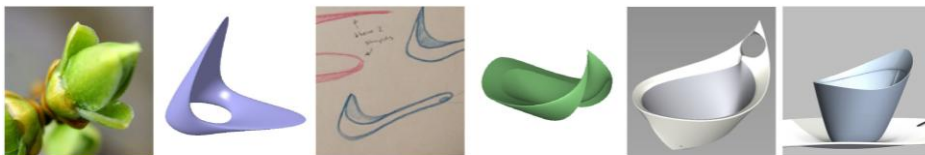


Figure 1 – Diary excerpts from participant RL; "Some chronological stages of the evolvment and development of the cup in the porcelain set... Studying the cup evolution reveals that the final concept is not far from a sketch made early in the project... Sometimes it can almost feel as though one is working in circles, but one must remember that every step serves to increase one's knowledge of a problem..."

In their previous design projects not involving diaries, it was difficult for some students to talk about the form design process and even more difficult to find the right taxonomy and arguments for or against certain preferences. With the involvement of the diary, students commented on the parallel profit of having developed relevant verbal capacities after the completion of the course, as well as being able to communicate their design process by

bringing forward arguments and findings without sidestepping to gut feeling and instinct.

At the commencement of the Advanced Form Design II course, students generally found it hard to accept the additional task of making self-reflections in parallel to their product design activities. The fact that self-reflections were considered as one of the assessment criteria motivated the students to find their routines and adapt to the additional workload. The more the students adapted to the given framework, the more they were willing to see the benefits in the course structure and the profit they achieved through writing form generation diaries. This is clearly reflected in last diary entry from one of the students:

"The documentation process is necessary in order to study the progress of the form development. By studying previous results one may gain new insight, in addition, one may avoid making the same mistakes as one has made before." – Participant RL

HINDRANCES TO DIARY DOCUMENTATION

The process of keeping diaries was considered firstly challenging, since students had to interrupt their form design process for self-reflections resulting in some discontinuity to their creative workflow; secondly it was time consuming, as students spent a significant period of time preparing and submitting their form generation diaries; and thirdly it was not without practical hitches, for example some students did not manage to upload their diary documents regularly. One explanation was tight deadlines:

"I experienced a heavy workload at the time and did not feel that I had the time to finish the diaries in time for the deadlines, so instead I wrote down simple main points in order to remember what I had done during each session and then completed the diaries at a later stage." – Participant JK

CONCLUDING REMARKS

The present study has highlighted the steps necessary to make a successful documentation of students' design processes using a diary data collection method. The contributing factors tackling the problems that had been

encountered in previous research were (i) using diary templates for directing the diary content and assisting the documentation; (ii) demanding regular diary entries to minimize recall effects; (iii) handling the diary documentations and submissions in a digital format; (iv) imposing the diary documentation as a course requirement to provide incentive for diarists; and (v) using supervision sessions as a secondary data collection method for observations and cross-comparisons.

By employing diaries during form design projects according to the course structure at Chalmers University, students were able to trace their routines, repertoire of visual forms, and other information, including their discussions with peers and supervisors. Additionally, students developed self-confidence and a terminology for argumentation. This seems to facilitate the construction of meaning, making decisions and drawing conclusions. The regularly delivered amount of diary data helped to provide the students with a self-critical insight on their form design approach, thereby helping them to become more articulate about what they do. The imposed self-reflections led to a higher level of understanding and critical judgment among the students, not least due to the parallel on-going supervision and discussion seminars.

The success of design diaries is ultimately a result of the collaboration between the research participant as diary author and the researcher as diary analyst, given that the researcher does his/her best to create a positive and productive diary-writing experience.

When deployed and administered effectively, diaries can successfully serve as a design education tool, facilitating the learning of students through self-reflexive mechanisms.

ACKNOWLEDGEMENTS

The authors' acknowledgements and gratitude go to the Torsten Söderberg Foundation in Stockholm/Sweden (www.torstensoderbergsstiftelse.se), which has been generously supporting our research on form generation processes from the very beginning. Additionally, the authors would like to thank Björn

Rehammar for his valuable contributions to this study, and also all of the students who took part in the courses and kept form generation diaries.

REFERENCES

- Babapour, M., Rehammar, B., & Rahe, U. (2012). A comparison of diary method variation for enlightening form generation in the design process. Paper presented at the Design Research Society Conference, Chulalongkorn University, Bangkok, Thailand.
- Blessing, L. T. M., & Chakrabarti, A. (2009). *DRM, a Design Research Methodology* (1st Edition ed.). London: Springer.
- Brett, S. (1987). *The Faber Book of Diaries*: Faber & Faber.
- Bucciarelli, L. L. (1994). *Designing Engineers*. Cambridge: MIT Press.
- Cross, N. (2000). *Engineering design methods: strategies for product design*: Wiley.
- Cross, N. (2011). *Design Thinking* (1st edition ed.). Oxford: Berg publishers.
- Cross, N., Christiaans, H., & Dorst, K. (1996). *Analysing Design Activity*: Wiley.
- Gutherson, P., & Ashton, P. (2000). The use of diaries / sketchbooks as a research tool. unpublished working paper. Advanced Research Institute School of Art and Design. Staffordshire University.
- Hope, G. (2009). Beyond Knowing How to Make it Work: The conceptual foundations of designing. *Design and Technology Education: an International Journal*, 14(1).
- Hyldegård, J. (2006). Using diaries in group based information behavior research: a methodological study. Paper presented at the Proceedings of the 1st international conference on Information interaction in context, Copenhagen, Denmark.
- Jones, J. C. (1992). *Design Methods*: John Wiley & Sons.
- Kolko, J. (2010). Abductive Thinking and Sensemaking: The Drivers of Design Synthesis. *Design Issues*, Volume 26(1), 15-28.
- Koriat, A., Goldsmith, M., & Pansky, A. (2000). Toward a psychology of memory accuracy. *Annual Review of Psychology*, 51(1), 481.
- Krathwohl, D. R. (2002). A Revision of Bloom's Taxonomy: An Overview. *Theory into Practice*, 41(4), 212-218.
- Lawson, B. (1994). *Design in Mind*. Oxford: Architectural Press.
- Lawson, B. (2006). *How designers think: the design process demystified*: Elsevier/Architectural.
- Loewy, A. F. (2008). Teaching Design Innovation: Methods for Promoting Innovation in the University Industrial Design Studio. Paper presented at the The NCIIA 12th Annual Meeting, MA.
- Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: an expanded sourcebook*: Sage Publications.
- Pedgley, O. (1997). Towards a method for documenting industrial design activity from the designer's perspective. Paper presented at the IDATER 1997 Conference.
- Pedgley, O. (1999). *Industrial Designers' Attention to Materials and Manufacturing Processes: Analyses at Macroscopic and Microscopic Levels*. (Doctor of Philosophy), Loughborough University, Loughborough.
- Pedgley, O. (2007). Capturing and analysing own design activity. *Design Studies*, 28(5), 463-483.
- Polanyi, M. (1983). *Personal Knowledge*. London: Routledge.
- Rieman, J. (1993). The diary study: a workplace-oriented research tool to guide laboratory efforts. Paper presented at the Proceedings of the INTERACT '93 and CHI '93 conference on Human factors in computing systems, Amsterdam, The Netherlands.
- Robinson-Riegler, G., & Robinson-Riegler, B. (2009). *Cognitive psychology: applying the science of the mind*. Pearson.

- Roozenburg, N. F. M., & Eekels, J. (1995). *Product design: fundamentals and methods*. University of Michigan: Wiley.
- Schön, D. A. (1991). *The reflective practitioner: how professionals think in action* (Repr. ed.). Aldershot: Arena.
- Schön, D. A., & Wiggins, G. (1992). Kinds of seeing and their functions in designing. *Design Studies*, 13(2), 135-156.
- Smith, M. K. (2001, 2012). Donald Schön: learning, reflection and change. *The encyclopedia of informal education*. Retrieved August 8, 2012, from <http://www.infed.org/thinkers/et-schon.htm>
- Ulrich, K. T., & Eppinger, S. D. (2008). *Product Design and Development* (Fourth Edition ed.). New York: McGraw-Hill/Irwin.
- Wild, J., Mc Mahon, C., Darlington, M., Culley, S., & Liu, S. (2009). A diary study of information needs and document usage in the engineering domain. *Design Studies*, 31(1), 46-73.
- Wong, Y., & Siu, K. (2011). A model of creative design process for fostering creativity of students in design education. *International Journal of Technology and Design Education*,
- Zimmerman, D. H., & Wieder, D. L. (1977). The DIARY: Diary-Interview Method. *Journal of Contemporary Ethnography*, 5(4), 479.