

THE PROJECT WORKBOOK AS A COMMUNICATION, ORGANISATION AND REFLECTION TOOL

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ABSTRACT

The project workbook as a collection of working papers, which are continuously generated during a product development process, is challenged by the digital media. The purpose of the project workbook is to maintain an overview of the documentation of the design process. For study groups, the mixed media constitutes a communicative challenge in the meeting with supervisors and external parties. Theoretically, all documents could be brought to either a physical or a digital form, so evaluations and reflections could take place in a fluid process. In reality, the hand sketches are produced continuously and partly also the physical 3D sketches while CAD models are only occasionally turned into subjects for comparative evaluations during the development process. This is a problem for the project-oriented learning, because it is based on the production of the repetitive knowledge. Such a fluctuating design process creates design representations in different phases that categorically belong to the same axonometric group, which also raises the question whether the project workbook should in fact be organized according to a design process model or taxonomy. The purpose of this paper is therefore double. Firstly, it aims to identify methods that can bridge the gap of documentation. Secondly, it discusses the pros and cons of the above-mentioned methods for cataloguing design representations.

Keywords: Project workbook, cataloguing, design representations, learning portfolio, sketch folder

1 INTRODUCTION

This study of the project workbook as a communication, organization and reflection tool is the result of a comparative study of guidelines for project work, which compared guidelines and written instructions to project work at Roskilde University (RUC), Copenhagen Business School (CBS) and Aalborg University (AAU) with the corresponding verbal instructions given at Denmark's Engineering Academy (DIA). The framework for the study was a study circle about didactics in engineering studies, led by engineering fellow Carl Jensen-Holm [1]. The result of the survey was a guideline for project work, which included sections about the preparation of project workbooks (hereinafter referred to as workbooks). Workbooks are still in being used, however, the number of visual design representations made on computers has grown and they occur at an earlier stage in the product development phases. This is a natural development given that project-based education seeks to approach a work form that can be characterized as being project work in practice. Study projects are rooted in a real problem, but the goal is primarily to complete a learning process. Therefore, the academic requirements (i.e. the use of theoretical knowledge and professional methods) carry more weight than the demand for a realistic result compared to practice. From the education perspective, the content of the workbook has been articulated as raw materials in relation to the product and process reports and as an important basis for the pedagogical and professional guidance. The students extract the essence of the workbook and present it in the process report while preparing the product presentation. Thus, they are exposed to metacognition during this reprocessing of the material. Metacognition refers the student's thoughts of achieved acknowledgements or reflections on their actions [2].

The workbook is considered a communication tool, as it continuously documents the outcomes of the problem solving process and the group's reflections and conclusions. The intention of the workbook is that group members and supervisors at any given time can gain insight into the state of the project. In reality, evaluations and reflections are continuously documented in connection with the manual 2D sketches and partly with commented photographs of 3D sketches as well as tests of function models,

while CAD modelling and other digitally produced material are only sporadically documented. This is a problem because the lack of documentation reveals that many students only sporadically reflect on how knowledge is generated through the previous steps of development and how this knowledge affects the following [3]. Therefore, the aim is to identify methods and/or tools that can ensure continuity in the documentation and reflection through knowledge acquisition in practice. [4].

According to those of our external examiners who work at design studios, the sections of the workbook that constitute a sketch folder are not of a professional quality. Although, the workbook is considered as raw material, this is a problem, because the worksheets are used in communication with external partners and because the students rarely rework the selected material before it is included into the process report. The question is then, how should the guidelines for preparation of workbooks be supplemented to ensure that:

- the workbook helps students to achieve a professional communication level?
- the workbook trains students in documenting of the argumentation for and reflections on the choice of solution based on CAD models incl. 3D prints or milling models?

The assessment of the workbook as an organizational tool is considered in relation to a design process model and a plan of activities that is aligned with the specific problems of the project. Together with the title page, the model and the plan, form the outworks of the workbook.

In addition, the workbook represents a reflection tool, as the template for the preparation of the worksheets focuses on "access to information", "new recognitions" and "interesting discoveries", as for example Prehan and Keldmann suggest [5]. Accordingly, the focus is on which knowledge is obtained, what the consequences for the subsequent analysis and idea generation are, and for the observations of the user meeting function models in real-life. In relation to study projects, it has been necessary to strengthen the theoretical and methodological approach. Therefore, the students have been encouraged to use the Pentagon of the Scientific Study [6] shown top left in Figure 1.

Learning Portfolio No. 1: Pentagon for Interaction and Interaction Inspiration Concept Development

Summary of task 1:
 1. Fill in the Pentagon
 2. Find a sample of a product whose interaction is based on the sense/given in the table, and it has been investigated by people how the interactions are experienced
 3. Outline 6 concept suggestions for exercise tools where the user can interact with multiple senses
 4. Reflect on your interactions

1. Problem formulation:
Lack of motivation for exercise

2. Academic purposes:
If anybody else also use of the study

3. Subject of the investigation:
Empiric, substance, data or phenomena

4. Tools of investigation:
Theories, methods or techniques

5. Investigation procedure:
List with all activities

Reflect on:
Procedure
It was difficult to find products that gave feedback, especially to the olfactory sense
Theory / Methods / Tools in relation to the desired result
The Pentagon ensured that I was in the field and had made me some thoughts about what I should observe
Factors of uncertainty
Reference for technology-level was not clear

| Product: | Sense of sight | Sense of hearing | Sense of touch | Olfaktoriske sanser | Sense of movement | Location | Social context | Technology-level |
|---------------------|----------------|------------------|----------------|---------------------|-----------------------------|----------|------------------|------------------|
| Microwave oven | Display a text | Beep sound | | Smell of food | | Kitchen | Meal | High |
| Musical toy of wood | Clear colours | | Texture | | Drag / press - to get music | Nursery | Noise is life | Low |
| Nintendo | Shows choices | Audio track | | | Finger movement | Home | One or no fellow | High |

① Concept: Music

② Concept: Track

③ Concept: Game

④ Concept: Leg Press

⑤ Concept: Arm Pull

⑥ Concept: Punching Bag

IPU: Interaktion 2017 Time Required Name:

Figure 1. Example of Learning Portfolio, Illustration of Pentagon by Group 3 [7]

The Pentagon uses terms such as theory, method and tools, but not the term technique. A discussion among the students revealed that it is because of the design profession's use of the term technique that sketching is perceived as a professional skill. This is part of the reason why the sketch folder sections have no argument why a given idea generation technique is pulled out of the 'toolbox' rather than other techniques. Nevertheless, there is a need to search for an answer to how the guidelines for the preparation of workbooks can be supplemented to better ensure that:

- the workbook contributes to developing the academic argumentation for technique/method
- the workbook strengthens the reflections on the benefit of idea generation and sketching.

Before the actual survey is commenced, the knowledge and tools the students were given will be presented in order to illustrate the nature of the frame for their approach to the workbook. Sections 1

and 2 of this paper were also used as background material for the questionnaire and distributed together with it in order to better capture valuable information.

2 QUALITY DEMAND OF THE PROJECT WORKBOOKS

The students' quality of communication compared to communication on a professional level is based on their layout, on the presentation of essential parts of investigations, on the communication of ideas and concepts through sketches and on the clarity of the argumentation for choice of solutions. A presentation of things that can support the students in developing the quality of their visual communication skills is found in section 2.2.

Learning quality is measured in relation to the documentation of collected empirical data, applied theoretical knowledge and academic methods, planning and implementation of investigations, as well as whether the workbooks show a reflective product development process. A reflection on what promotes the students' academic arguments for method selection and their reflections on the benefit of the methodological development process is found in section 2.3.

In the quality of organization, it is hard to evaluate beyond how easy it is to find a given document, even though the structure of a workbook should also inspire creative thinking. The students are encouraged to skim the workbook on a weekly basis in the ideation phase to get inspiration from the material. However, there is a dilemma between the secure progress in the product development and the secure search of the solution space, as will be explained in section 2.1.

2.1 Organization of Worksheets

The development of guidelines for workbooks is based on the last three years' worth of workbooks produced by industrial design projects in the 5th semester, as a tool for organizing the design representations, which are organized continuously during the product development. In 2015, design representations had again more or less structured conquered the surfaces of the group rooms, after a number of years with service design projects where tools are of such a size that they promote the organization of hangings of sketches and design boards [8].

"The problem solving process with its constant interaction between logic and creativity involve repeated revisions of the previously adopted solutions, as creative thinking does not acknowledge conclusive solutions. The conclusions of the subsequent logical assessment - based on the available evaluation criteria - may reject solutions that can later prove beneficial due to the fact that the evaluation criterion is development through the project work" [1]. Such a process may suggest a taxonomic organization of the documents, but the initially selected design process model provides

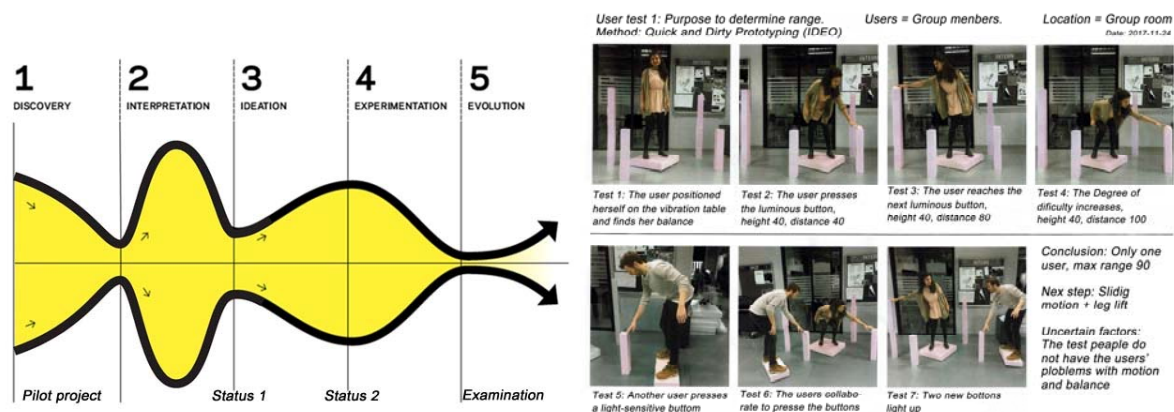


Figure 2. The Design Thinking Model, modified in relation to the project and a working paper

a structure with which the groups also organize their project work. In 2017, all groups chose to use a modified version of IDEO's Design Thinking Model [9] for their user-oriented semester projects, see Figure 2. The semester began with a pilot project where students identified a community relevant problem in relation to exercise and a lack of motivation which could be helped with a physically interactive product. Simultaneously, they were introduced to the workbook in a workshop where they had to develop a structure for the workbook themselves. The design representations, that the project was expected to generate, were illustrated by using Pei all's Taxonomic Classification [10]. This was supplemented by an unstructured overview of working papers, which the students were expected to

need in order to cover the learning goals of the project module, as well as examples of how to section the workbook based on Perkins and Beck's proposal to organize the documents according to a chosen design process model [11]. In all six workbooks from 2017, the sections were organized according to the Design Thinking Model as opposed to the four workbooks from 2016 and the six from 2015, where the students had used the taxonomic cataloguing of the worksheets. When comparing these workbooks, it is clear that the taxonomic solution keeps the process open whereas sectioning based on a design process model encourages the ongoing completion of activities and archiving of the documents in connection with the logical assessments. Which solution is preferred depends on the purpose and learning goals of the project module. In the semester that gave rise to the present survey, the focus was on activities in the experimental phase, which is best achieved by organizing the worksheets according to a design process model.

2.2 Professionalising of the Workbook

On several occasions our external examiners have pointed out that the students should work with the graphic expression as well as visualization of methodical selections with reflections on the result by using sketches and models because they thereby articulate the workbook as a professional tool.

The students received examples of working papers from other programmes and references to textbooks [12], [13], and in 2015 and 2016 the students also received examples from professional designers' presentation portfolios. This approach worked well in conjunction with a course in Exhibition Design where the students were expected to create a presentation portfolio in order to illustrate their abilities for potential producers and design studios. However, this approach did not work as intended with the workbook, although one of the intentions of introducing the workbooks to the students was to teach them how to illustrate their ability to work methodically in a visionary manner.

A previous study of which qualities owners of design studios would like to see the students present in their presentation portfolios [14] had shown that our students should focus on illustrating the parts of the design process they mastered. The feedback from the students revealed that it seemed overwhelming to work towards these goals, and therefore they gave up. Based on this, more emphasis has been placed on the fact that in the study contexts, the workbook is considered as raw material and that means the material chosen for the process report must be reworked.

2.3 Worksheets versus Learning Portfolios

Worksheets are A3 sheets provided with headers for a title that conveys the nature of the content or purpose, date and references as well as footers with fields for arguments, reflections, uncertainties and decisions on the importance of content for the further course of the project. In a course module that supports the project module, learning portfolios are used to ensure that the students have understood how theories are translated into practice and have understood how to use methods, tools and techniques. The learning portfolio is designed as a template with explanations of methodical grip, testing and reflection, as shown in Figure 1. The students also work with a common electronic folder with decentralized access as Guan and Abdel-Wahab suggest [15]. The purpose of learning portfolios is to inspire the student to design their worksheets. By using tabs with Pentagons to divide the sketch sequences [7] instead of a header on each page, group 3-2017 found that they saved some time. Other groups focused more on working on the individual worksheets, so they could deepen the product development process by using the workbook. This led to a discussion of whether the workbook could replace the process report, provoked by some teachers who found that the students spent too much time on presentations rather than research and experiments. The proposal was rejected because the limited number of pages, which the students were allowed to hand in for the exam, would result in heaps of unorganized documents left over.

3 RESEARCH BY QUESTIONNAIRE

This survey was inspired by the topic of Nordcode-2017: "Traces of the Design Process." The Nordcode Network brings together researchers who work with the communicative aspects of artefacts, aesthetic qualities of physical products and objects as well as design processes related to the creating of artefacts. The many inspiring presentations gave rise to this survey as well as the recognition that more researchers in the network also focus on developing similar tools to help train students in professional argumentation, reflection and communication during the design process. To survey which

methods and tools other researchers used in their efforts to teach the students a knowledge-based reflexive practice by a kind of process documentation, a questionnaire was distributed to the network of Nordcode. The questionnaire focussed on the form development process, because form is seen as the unifying element that reflects the entire design process. The questionnaire had special focus on methods to promote process documentation and reflection on the interaction between sketching, experimentation and prototype development, including 3D modelling. There were also questions about their experience with shared workbooks, sketch folders and feedback portfolios as well as worksheets and learning portfolios in teamwork. And specifically questions about the shared workbook which is considered as a tool to build a "toolbox" that collected the students' experience in relation to the use of theories, methods, tools and techniques in the design process. Additionally questions about the feedback portfolios considered as a tool for supporting the students in developing a personal style or artistic expression. Finally, they were asked if they use or refer to a specific written guide for the preparation of workbooks or process report.

4 FINDINGS

The use of workbooks in design subjects can be traced back to the mid-1990s, where design students at the Royal Danish Academy of Architecture began to put their worksheets into A3 ring binders in rigid cardboard instead of storing them as loose sheets in a cover. Whether it was the project-oriented education at RUC, AAU or CBS that paved the way is unknown. Through the mutual inspiration between the students in the last academic year and their teachers, the workbook achieved a form and a status as process documentation in line with the engineering reports. The worksheets were provided with headlines as previously mentioned, while reflection was applied during the instructions or presentation for external professionals. The workbook was first introduced as a tool in a kind of craft's apprenticeship from which it spread to other design programmes. Among these is Danish Design School (KADK), where students included scaled down posters and photos of models together with the summaries they made for each other in connection with their status presentations.

The students control the state of the paper worksheets as well as file formats on KanBan or Scrumboard with "done" = "inserted in report". The survey revealed that students do not use the field "ready to verify". This procedure is supposed to ensure that the quality of documentations, including whether arguments for method selection, reflections etc. have been used as specified for instance in a review procedure.

At RUC [16] as well as at Linnaeus University (LNU) [17], students prepare individual workbooks called feedback portfolios while they participate in a group project. This should result in more attention on each single student's development, also in relation to them finding their own personal expression. This way the student is able to reflect on the nature of his or her own design activities and on how the use of design tools influences the development of the form [18].

The structure of the electronic folder follows the way the students' choose to organize their project work. They do not learn to use professional folders with content requirements, who are allowed to edit what or standardized procedure of approval. Here it would be natural to encourage the students to make "ready to verify" folders with reference to their toolbox, or alternatively to add "reflection tabs" with the fields recommended by Prehn and Keldmann as well as a method or a theory field [5]. The term "learning portfolio" does not seem to be used much in the design profession; however, it is being used at Industrial Design at AAU and Performance Design at RUC. For corresponding implementation of knowledge by templates with demands of content and layout terms such as "task" or "poster" are being used. It is up to students' themselves to take responsibility for designing their working papers in relation to the project work, but demands for the delivery format are instructive.

At KADK the problems with the missing documentation and reflection are solved in courses or workshops, where the student either develops artistic methods or explores theoretical and methodological approaches while they switch between using sketches, experiments and prototype development, including 3D CAD modelling. Developing artistic methods implies, as Hove highlights, a repetitive production of both hand sketches and computer-generated models in a reflective practice [3]. The workbook is on its way to achieving the same status as the process report, assisted by the growing interest in the artistic process.

At Malmö University, the students must submit commented screen dumps during the 3D CAD modelling course. At Aalto University, the students both learn to document their process with paper sketchbooks and with digital sketchbooks. Guidelines for preparation of the workbook as

documentation for a shared project are included in the description of the programme and have been adjusted to the specific learning goals in the different semesters. At LNU they only have general guidelines preparing feedback portfolios. The students themselves are responsible for preparing the feedback portfolios and for providing feedback to all members. Feedback portfolios have some qualities in relation to clarifying the success criteria in relation to the solution of sub-tasks in the shared project and to assessment of own competencies. Mac and Hagedorn-Rasmussen also emphasize that feedback portfolios can sharpen the arguments in the groups [16]. This is true, but on the other hand, more replies to the same sub-tasks can also give rise to conflicts in the teamwork.

5 CONCLUSION

The survey reveals that the uses of workshops that focus on the artistic approaches have been beneficial to closing the gap of documentation and reflection in the transition between hand sketches and CAD modelling. Demands for submission of commented screen dumps during 3D modelling and switch between demanding workbook in paper and in electronic format also contributes to closing the gap. The survey reveals an opportunity to reinforce the arguments for method selection and reflections on the benefit of the idea generation process. This is done by encouraging students to either use the “ready to verify” field in Scrum boards or to use pentagon and reflection tabs. The experience with the latter is so sparse that the effect should be investigated further. The survey did not contribute to clarifying the pros and cons of cataloguing worksheets by following a design posed model or according to an axonometric.

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