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DESIGNING AND FACILITATING LEARNING IN A COOPERATIVE SETTING

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ABSTRACT
This paper unfolds how learning for design-engineer students can be established and facilitated in a dynamic research setting, between academics and industrial partners. It challenges years of experience from teaching traditional Problem Based Learning, and it requires new initiatives to ensure the learning of students. Student involvement in research projects appears to be an increasing trend, which is affecting both the practice of research and education.
The Danish research project 'Innodoors' investigates, through various initiatives, how User-driven innovation can contribute to innovation and affect the culture of innovation in the building sector. One of the research initiatives was originally probing hypothesizes through student projects, where the students not only play a practical and performing role, but also engage in a rather equal partnership with the academic. This was also the case for the involved industrial design students, but they found it necessary to redefine the initial, given hypothesis, which surprisingly uncovered knowledge deficiencies for both students and academic; yet, it contributed to a mutual learning situation.
Educators are facing new challenges with the responsibility of facilitating learning for students, and the student involvement is changed as they are empowered by orchestrating the projects - this is the focal point for the paper.

Keywords: PBL, research project, co-planning, mutual learning

1 INTRODUCTION

Conducting research and facilitating learning are activities not often tied together. Instead, it is more common that teaching is based on research, without influence going the other direction. The principles of Problem Based Learning (PBL) offers integration and mutual benefit of the two – academic research and student learning. "Problem-based learning (PBL) is an instructional method in which students learn through facilitated problem solving. In PBL, student learning centres on a complex problem that does not have a single correct answer. Students work in collaborative groups to identify what they need to learn in order to solve a problem. They engage in self-directed learning (SDL) and then apply their new knowledge to the problem and reflect on what they learned and the effectiveness of the strategies employed" (Hmelo-Silver 2004, p. 235). So, at the very heart of PBL is a problem to be solved by students. It is a well-documented fact that the task of solving a problem motivates students to engage in the learning activity (Collins et al, 1989). A problem, so to say, triggers students and encourages them to collect relevant information, transform it into knowledge, and then act upon this new knowledge; they apply this newly gained knowledge and reflect upon it. Therefore, it can be argued that the SLD situation is highly affected by the choice of problem.
In PBL settings, the academic holds a certain responsibility in creating or taking part in creating the frames for student learning. The starting point for a PBL project is the problem, and the academic is bound to either provide the students with a relevant and appropriated problem or participate in identifying such a problem. The character of the problem must match the learning goals of the curriculum and the characteristics of the education. And likewise, the complexity of the problem must match the capacities of the students and not confound, frustrate, or bewilder.
A PBL process should be designed to go through six phases from 'Problem Scenario' through 'Identify facts', 'Generate hypothesis', 'Identify knowledge deficiencies', to 'Apply new knowledge ' and 'Abstraction' *(Hmelo-Silver 2004, p. 237);* firstly, by engaging in the problem at hand, investigate into identify facts and generate hypothesis. This then leads to the SDL process in which the students

indentify what knowledge should be gained - often in correspondence with the academics - and seek to apply this newly gained knowledge in solving the problem at hand, and reflecting upon it, through an abstraction.
The traditional PBL learning cycle is applied throughout the entire education at the School of Architecture, Design, and Planning, and it is highly relevant in the main-project, at the third Master Semester for Industrial Design students. The theme of the main project is "Design Research and Strategy", and the objective is to "strengthen the student's professional self-conception and his/her ability to work with aspects of design in relation to current research themes" (Studyguide 2009). The third semester at Master level goes before the students´ final thesis and just prior to them leaving the educational system as students, to enter into working life. At this point in the education, the School of Architecture, Design and Planning wishes to make students reflect, at a meta-level, on their obtained knowledge, skills, and competences, and importantly, relate this to their desires for a future carrier. With the "Design Research and Strategy" theme the students are asked to consider and define a certain theme that they wish to explore further to strengthen their self-conception and professional profile. The students are required to contact an academic with relevant research interest and maybe an ongoing research project relating to the theme.
This paper shows a case of collaboration between four students and an academic, with a position divided between teaching and research. The research project, Innodoors, will illustrate how a traditional PBL situation has been challenged. At the School of Architecture, Design and Planning there is a tendency towards combining teaching and research activities for mutual benefits. The argumentation for joining teaching and research is not the scope of this paper, but this contribution focuses on the challenges for the academics and students in the constellation.

2 INNODOORS

In the summer of 2009, Jeld-Wen, an international door and window producer, and an interdisciplinary team of academics from Aalborg University established the User-driven innovation research project Innodoors with funds from the Danish Enterprise and Construction Authority. The Innodoors project has other additional partners from the building sector - predominantly from Jeld-Wen' value-chain. The project explores how methodologies from User-centred design can cultivate innovation in production companies and value chains. The research project is designed to facilitate a series of User-centred design activities for the involved parties to gain 'hands on' experiences and knowledge of the methodologies.
The academics represent three different departments - Department of Architecture, Design and Media Technology, Department of Production, and Center for Industrial Production. The different departments have predominantly shared research interests within the project, but due to the combination of several disciplines, there are also research interests that tie to a certain discipline. The common research interests are explored and investigated in close collaboration between the academics and the involved parties, but the discipline' research interests are driven by each discipline, and it has been a common trend that these research interests were explored in collaboration with students, as each involved Department represents one or several educations from which students were offered participation in the project.
This paper focuses on the involvement of industrial design students at Master level, which were asked to investigate a problem area concerning companies' lack of User-centred design activities in the development process. Over the past decade User-driven innovation has become an important activity in strategic and product-oriented development (Palsbro 2008). However, many companies are not certain of its relevance and benefits in relation to the investments in user research. Based on this notion, the hypothesis was; "companies with little or no experience must gain insight into User-centred design through guided and hands on experiences in actual projects before understanding its value and engaging in the planning or practice of such activities – *how can designers facilitate the process?*"

2.1 Hypothesis Redefined

As the students engaged in the project, they addressed the same problem scenario of failed innovation ability in companies; however, the students' experiences from the early collaboration made them question both the problem formulation and hypothesis. Still, it was clear to the students that the employees in the company had little experience with User-centred design, and that this would reflect

in the conversations and planning of User-centred design; however, the students decided to view this as a challenge rather than delimitation. In facilitating collaboration with the employees, the students were challenged with imbalance and disproportion in the knowledge areas, and had therefore limited shared knowledge to build on, but they were determined that this could be surmounted if it were addressed as a design task. As a result, and within the same problem scenario, the students changed the problem formulation from the above mentioned to *how can practitioners be involved in the planning of User-centred design activities?* This was based on the hypothesis that practitioners with little or no User-centred design experience would not become competent enough to practice User-centred design from participating in few activities with, for instance, field-material collected by the students. Instead, the practitioners should be provided with a greater awareness of User-centred design methods through a carefully designed activity.
With this new hypothesis the students addressed the planning situation of User-centred design and aimed for a constructive planning dialogue between the company and designer, where the competences from both could be brought into play and the interdisciplinary cooperation emphasized. The students concluded that planning User-centred design activities in cooperation with a manufacturing company requires an overview of and insight in selected methods.

2.2 Participatory

From former projects, the industrial design students have strong skills and good competences within User-centred design, which enabled them to examine, organize, and categorize methods. The students did also relate their work to the development model of the company. Here the intention was to better understand the context and culture of the company in order to make the integration of User-centred design more feasible.
There are various methods to apply if a company is willing to engage in this type of work. The extent of methods can cover throughout the entire product development process from identifying problems to testing solutions. This testifies to a large number of methods that can be applied, however, this is difficult for people with no or little experience to comprehend. This was the challenge the students decided to address.
PARTICIPATORY is a physical tool in form of a board game, which is created to support companies in corporation with designers in defining which users (end-user, influents, and internal users) to address and the methodological approach. The choice of a board game, something physical, as a media for collaboration is the result of its ability to involve participants and create a united confidence and shared understanding of the ongoing activity. PARTICIPATORY is created with the purpose of enhancing discussions, conversations, and questions in the planning process of the project, and due to the tool's physical form, it can be placed between the participants and be the core of the process, by which everybody interacts and feel as equals in the dialogue.
PARTICIPATORY is made to encourage User-centred design in manufacturing companies and strengthen designers' possibilities to make the companies relate to the methods. The game provides a designer with a well-organized opportunity to communicate and plan User-centred methods in cooperation with a steering committee of a manufacturing company. Together the varieties of users are discussed and here the designer plays a central role due to his/her experience with User-centred design. It might for instance be that a designer identifies potential users that currently are not customers of the company.
PARTICIPATORY is used under meetings between the steering committee of a company and a designer. When taking the game into use, the designer acts like a facilitator of the meeting. PARTICIPATORY is designed for usage in four meetings throughout the design process, with the duration of one to two hours. The game contains four squares, which relate to four phases in the development phase, and it is the intention to plan and initiate these phases by playing the game.
The designer introduces the steering committee to PARTICIPATORY. The game consists of a game board, method cards, expectation cards, a game-counter, and a set of guidelines. The game is as mentioned divided into four phases; identification, concept development, detailing, and realization. Each phase is additionally divided into three squares; 'Who and Why', 'What and When', and 'Expectations and Initiatives'.

Figure 1. The PARTICIPATORY game

The game is played from the centre and outwards. A game-counter is moved around the board indicating the focus. The game-counter controls the discussions. The 'What and When' square carries appertaining method cards, and every card represents a method for user research. These should be chosen from the election of users and desired output.
The 'Expectations and Initiatives' square carries appertaining expectations cards; these cards represent questions for the steering committee and the designer to consider at the end of the meeting.
The game starts with placing the game-counter in the centre of the board with the initiating problem suggestion for the project presented. The first step is to define at which phase the project should start; a project might just be concerned with investigating the usability of a given product, and therefore start at one of the later phases. The game-counter is then placed on the desired phase. The second step is defining 'Who and Why' by choosing the relevant users and the research agenda through a brainstorm. Now the game-counter is placed on the 'Who and Why' square The brainstorm is made with post-it notes, which are placed in the middle of the board. The post-its are discussed, and the users to focus on are chosen on this basis. The third step is to select methods that correspond to the 'Who and Why'. The game-counter is now placed on the 'What and When' square. The designer presents the methods that could attain these desired outputs one by one. The potential methods are discussed and evaluated by the designer and steering committee. A sample of methods are chosen and placed in chronological order. In the fourth and last step the game-counter is placed at the 'Expectations and Initiatives'. Now it is about recapitulating and documenting the discussions and agreements. The expectations for the next phase is discussed on the basis of the appertaining 'Expectations' cards. The dictions are noted and act like a contract for both the designer and the steering committee. The contract describes the assignments that are going to be executes until the next meeting/phase.

3 THREE FOLD LEARNING

The collaboration between the students, company, and academic on the research project offered new knowledge for all involved parties. The company gained knowledge of User-centred design with a fairly good insight into the methodologies; what the different methods could provide in terms of information, how such activities could match and support ongoing internal processes, and how costly, in terms of resources, would the different activities cause. Based on this it can be justifiably argued that the general and involving introduction through a game made the practice and benefit of User-centred design more transparent to the employees. It hereby enabled the participants to engage in future User-centred design activities at a more professional level, and in this sense, the game can be understood as an educational tool for companies that want to implement a User-centred design approach.
In relation to involving employees through PARTICIPATORY, the students experienced the games dependency engagement and openness towards User-centred design. The students also learned that employees with an open attitude quickly can engage themselves in the discussion, in a fruitful manner.
The students gained skills in developing design games and facilitating these for people with different

professions. The students also achieved an extensive and more explicit knowledge of User-centred design and its methods. Knowledge of the rationalities, mechanisms, and constraints within industry was likewise obtained by the students, who were taught to address the employees in a pragmatic manner.
The students' understanding of their own skills, knowledge, and competences was developed and put into a perspective of how to apply it; they became aware of what professional role they could master, when entering working life. In this sense, the project supported the professional self- conception, which is essential to establish at this point in the education. It is the argument this paper that the increased professional self-conception have raised the students' general competence level as they, after having completed the project, had a better understanding of their own capacities; capabilities and professional role.
For the involved academic, one particular teaching was especially valuable in relation to the research project. The students' work reframed the academic's perception of how User-centred design could be introduced to employees with little or no experience. The academic recognized an alternative approach and strategy to the introduction of User-centred design and acknowledged the offered transparency of the practice of User-centred design. What the students had developed was a qualified approach to integrating User-centred design into the existing practice within a company. In addition, there was throughout the project a considerable number of deep and fruitful, methodological discussions with the students. From this it can be argued that the collaboration between the academic and the students did not only provide a learning situation for the students, but it was indeed also a mutual learning situation for both students and the academic.

4 CONCLUSION

The planning of student learning from a curriculum with thorough progression of skills, knowledge, and competences can be accomplished through teaching and weekly supervision, which is central to the PBL model applied at Aalborg University. Involving students in ongoing research projects is currently becoming a common trend in the teaching methods for Master-level students.
Providing the students with a problem scenario and a certain hypothesis to investigate can in fact undermine the PBL cycle. Defining a hypothesis for the students to investigate can support the research project in a desired way, but it can, however, also limited the students' learning as they miss out on the early and initiating activities of defining, understanding, and addressing the problem. In addition, it can be argued that such approach is not respecting the complexity of the addressed problem. Instead, however, this approach is trying to turn it into a tame problem, while the fact is that these types of problems have no definitive formulation (Rittel 1972, p. 392). Tame problems should not be strived for in PBL situations, because "to foster flexible thinking, problems need to be complex, ill-structured, and open-ended; to support intrinsic motivation, they must also be realistic and resonate with the students' experiences" (Hmelo-Silver 2004, p. 244). Hypothesis should not be given to students; instead they ought to be provided with a clear definition of the problem scenario, and within this, find their own approach. The unexpected turn and the new hypothesis revealed a new situation in which new knowledge deficiencies also appeared. The interesting aspect of this scenario is that it not only reflects the knowledge deficiencies of the students, but it is also likely to reflect the knowledge deficiencies of the academic.

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