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an engaging entry to a transdisciplinary master education

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The 'Kick-off project'

- an engaging entry to a transdisciplinary master education

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ABSTRACT

For students starting at a master program where transdisciplinary processes are an integrated part of the curriculum, it can be a difficult adaption when they have to mix methods and theories across boundaries. The overall questions dealt with in this paper are how to introduce students to understand and use the transdisciplinary approach through a problem based design project, and how to give the students a meaningful and engaging introduction to their future study. The theory behind the pedagogical approach Problem Based Learning (PBL) is reflected in a "Kick-off Project" from a new transdisciplinary master programme in Lighting Design. During the project the transdisciplinary elements of creating meaning and value through lighting design, the important elements of PBL and the process of applying this through a playful process model developing and realizing a 1:1 lighting design project in a specific context will be introduced. The results show that it is possible for students to make a meaningful design project showing insight in and understanding of a transdisciplinary education, combining PBL approach and a design model.

Conference Key Areas: Sustainability and Engineering Education, Curriculum Development, Engineering Education Research

Keywords: Problem based design, problem based learning, transdisciplinary education, lighting design

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INTRODUCTION

Several educational institutions have started interdisciplinary or transdisciplinary master educations. (We are using the term transdisciplinary according to Meeth [1]). For students starting at a master program where transdisciplinary processes are an integrated part of the curriculum, it can be a difficult adaption when they have to mix methods and theories across boundaries. A new transdisciplinary science and engineering master program in Lighting Design was launched in 2014 at Aalborg University integrating lighting technology, architecture and media design. The students have different educational backgrounds representing these fields as well as different nationalities. One of the main concerns was how to introduce the problem based learning (PBL) and transdisciplinary design aspects of the program to give the students a common understanding of and the ability to combine technical and humanistic knowledge in an integrated creative design process. These challenges are met through the pedagogical approach of the Lighting Design program, which is based on PBL [2] [3]. All Aalborg University programs are using the Aalborg PBL model and first year bachelor students get an introduction to the model [4]. The questions dealt with in this paper are: How to introduce students to understand and use the transdisciplinary approach to Lighting Design through a PBL design project, and how to give the students a meaningful introduction to their future study.

1 BACKGROUND

1.1 Lighting Design

Lighting has undergone a revolution in recent years. New sensor technologies and computation intelligent control of light, energy-saving potentials and new LED technology can be applied to a sensitive and cultural architectural lighting design approach. The process of designing with light have to move away from a split focus between a rational engineering and an intuitive architectural approach to a complex transdisciplinary design process integrating media technology as knowledge area, methods, tools and equipment [5]. The Lighting Design Master has duration of 2 years. After the first semester in 2014 a small survey was made. Here it became evident that for many students it was their first project using PBL and a transdisciplinary learning approach was not easy. The problems were related to project work, cooperation and communication as well as difficulties of transferring the traditional theoretical 3 half - days PBL introduction into their 15 ECTS semester project. On that background, it was decided to change the introduction to integrate PBL and Lighting Design in a student project, and the concept of a 5 ECTS “kick off project” as an entry to the PBL methodology, the transdisciplinary approach and creative potentials in designing with light was defined.

1.2 Pedagogical approach - PBL and The Lighting Design Experiment

The pedagogical background for the Lighting Design master program is a process model, The Lighting Design Experiment (LDE) [5] and Problem Based Learning and project organized group work (PBL) [6]. This LDE model supports students to structure complex problems in such a way so they are able to integrate and apply knowledge from different disciplines [7]. Students define their projects within a semester theme, and most of the problems addressed by students in the different semesters are interdisciplinary by nature, since students start from a given theme, finding a problem to solve, analyse and use several disciplines to address it and

solve it – always facilitated by a teacher [8]. The process is the anchor of the project and is based on an iterative process of idea generation, problem area analysis leading to a final problem statement, design, implementation, test and conclusion [4].
The 'Kick-off project' is based on a design-based learning approach, the Lighting Design Experiment, where students in their project should be creating narratives by transferring, translating and transforming knowledge on light from different fields [10]. Design based approach has shown successful results for students developing skills and understanding, when they needed to undertake solutions of complex and sometime ill-structured problems [10] [11]. According to theories of PBL and situated learning, designing creates contextualized and authentic learning, because design tasks force students to understand and work in an environment that demands skills and domain knowledge close to real work environment [12]. We find that design-based learning in general and Lighting Design in particular is well connected with PBL project work which will be the pedagogical approach for a 'Kick-off project at the Lighting Design master program first semester. This approach has potentials for using the 'Kick-off project' as motivational and engaging factors, while knowledge about different aspects of lighting design are mediated through student's projects. At the same time knowledge about Problem Based Learning are applied during students learning process.

2. METHODS

2.1 The experiment as a tool, how do we analyse the kick-off project

The 'Kick-off project' is an experiment to introduce new master students to Lighting Design, PBL and to get knowledge about their new transdisciplinary learning environment. The kick-off project has been running in 2015 and 2016. 56 student's projects have been developed in 13 groups, which consist of a design task scale 1:1, a written report and a presentation of the design solution in context.
We have used an exploratory case-study approach [13] in combination with the descriptive, mixed- method case study [14] [15] [16] to investigate the process and results of the 'Kick-off project.
This examination explored the process of learning by design within the context of an intro project. Furthermore, we are evaluating the PBL competences acquired during the project work: analysing all students in particular this study addressed the following research questions:
1) How did the students show understanding and ability to define a narrative and the narrative they have chosen into the overall project theme: "designing with light"?
2) How did different aspects of the project process reflect the PBL competences.
3) Did the students integrate different disciplines in their project?
4) How did the 'Kick-off project' function as a good introduction?

We have analysed the 13 reports from two years using the four parameters:

1. The PBL structure, understanding of the process

2. Ability to analyse the context and formulate chosen narrative leading to the problem statement and the design they wanted to work with where light is one element in a transdisciplinary design.

3. Ability to create a narrative through light integrating the amount of disciplines and methods needed for the design solution

4 The general quality of the student's productions (the narrative using light, the report and the reflection.

3 KICK-OFF PROJECT – SEEING THE LIGHT

Fig. 1, The Cast Collection*, Fig.2* Lighting faces. *Fig. 3* Projecting POP art

The 5 ECTS kick-off project, 'Seeing the Light – Creating new Narratives' [9], takes its departure in a real-world scenario, where a playful approach to lighting design will create new ways of seeing how light can create new narratives in the unique, historical and cultural context of The Royal Cast Collection by the harbour front in Copenhagen. The aims are to give the new students an experience and understanding of the complexity of seeing and understanding light and lighted objects in spatial contexts by collecting knowledge from different fields and synthesize this knowledge into a problem statement, and to explore new potentials through the development of a lighting concept, reflecting the concept of PBL. Referring to the LDE the design process will develop and test solutions in using different methods and theories related to the areas; lighting, architecture and media technology.
The Royal Cast Collection consists of more than 2000 plaster casts of sculptures of the human form from across Europe, and which can reveal narratives of everything from pagan gods to Christian traditions. The sculptures are created for specific sites and for daylight conditions. The students were asked: *How can light create new narratives in The Royal Cast Collection?*
During the first week, the students were given an introduction to methods and tools related to the three academic fields and three courses of the semester. A lecture on Architecture introduced how to see, analyse, understand and document objects in different context, the narrative, visual fantasy. The students were introduced to the lighting equipment and lighting technology. The curator of the collection gave an introduction to the history behind the sculptures and the old warehouse. Finally, the concept behind Problem Based Learning and methods related to how to work and design in groups was introduced through two sessions during the first week. The students were divided in groups of 4 -5 representing different fields and nationalities and allocated a supervisor. The process was structured in three steps referring the process of PBL and the model of the LDE [10].

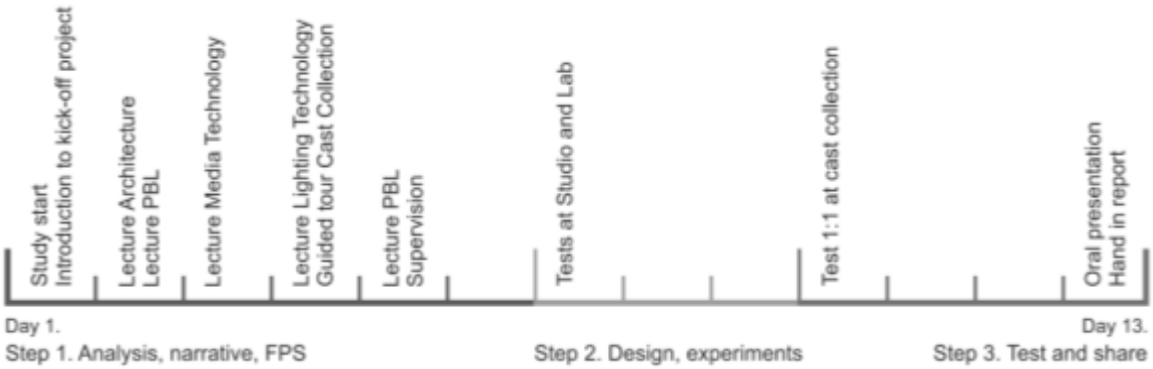

Fig. 4. Timetable for the kick-off project, knowledge input, 3 steps and tasks

4 RESULTS

As part of the results from the 13 projects, one characteristic project is selected to roughly illustrate the structure and steps in the process.: The project title is: 'Popping up in the Royal Cast Collection. Experiencing pop-art and ancient culture in a new light'. Focus is on the process of working with the narrative of the Greek God Apollo investigating how light can express the contradicting sexuality of the sculpture [17].
Step 1: Analysis of the context and choice of narrative. The focus area was defined on basis of observations of the sculptures, the architecture and the light. Knowledge about the art history and the user group was given by the curator of the museum. Knowledge on the fact that gender and sexuality is a very discussed topic and relevant to chosen statue was studied and included in the narrative: "Provoking and highlighting Apollos contradicting sexuality. The statue is not as masculine as other male statues". On that basis, the final problem statement was defined: *"How can the contradicting personality of Apollo be highlighted through light".* The final problem statement is based on analysis of four different knowledge areas in the context, art history, architecture and effects of lighting as well as topics related to society in general.
Step 2: In order to answer the FPS several design experiments were conducted. The positioning of the sculpture in relation to other sculptures, the walls and window was defined. The lighting fixtures were tested. Coloured light (pink and blue) was introduced to add an extra layer to the experience and perception of contradicting sexuality. The students then started experimenting with the effect of the shadows through digital renderings using 3Ds Max, V-ray and Photogrammetry and by tests in the studio and the light lab at the university as well as tests at the Cast Collection.

Fig. 5. Design Experiment in light lab and at Cast Collection exploring male and female characters.

Step 3: Test and charring knowledge. The students tested the findings from Step 2, at the collection, adjusted it and it is communicated in their project in report, Furthermore their narrative is presented through a 1:1 lighting set-up at the cast collection and through simulations.

In the following we are showing an overview of the Kick-off projects from 2015 and 16 we have made a table showing 4 elements in the process of making a project. It is of course an abbreviated illustration of a very rich picture of 13 projects. The 4 elements are: The Narrative, the Final Problem Statement, the Transdisciplinary elements defined by the number of different knowledge areas and methods combined in the process and finally the PBL structure.

The narrative	Final Problem Statement (FSP)	PBL	Disciplines
A woman is punching a man. Two characters in a pop-art theme.	How can a humoristic lighting installation make people more interested in the museum?	max	4 4
Mortality and loss: a woman is going through the third of the five stages of loss – the stage of bargaining as she prays a night in a church for her dying son.	Is it possible to use lighting to bring out the emotional stage of loss? Analyzing the history be-hind 5 medieval tomb sculptures.	max	4 methods 3 fields
Depict 8 bust casts in a manner that would embrace the superior socio-economic status of their character around the idea of Nouveau Riche reflected in reflective, shimmering golden effect.	How do you create a narrative without words and by only using lights?	max	6 methods 3 fields
Bringing life to the busts and the space in or-der to support the ware-house atmosphere in a more compel-ling way.	With what kind of light settings can you alter the existing facial expressions of busts in a dramatic way?	max	3 methods 3 fields
Present the story about slavery that has been in Denmark. The statue is used as a canvas and tattoos are used to pay attention to this situation.	How can we tell a story though projected tattoos on one of the statues in the Royal Cast Collection at the West Indian Warehouse?	max	4 methods 2 fields
Provoking and highlighting Apollos contradicting sexuality. The statue is not as masculine as other male statues.	How can the contradicting personality of Apollo be highlighted through light?	max	6 methods 3 fields
Bring out the story within each individual exhibit in a group consisting of statues in a row on one side and a relief on the opposite side to create interaction and an overarching narrative,	Bring out the story within individual exhibits. Combining those stories to create interaction and an overarching narrative. Creating interactive space to involve the visitor.	middle	5 methods 3 fields
The story of Lacoon and his sons – the way the father faces death – weather stoically or by creaming and revolting against the damnation.	How can we, through the use of light, make the audience aware that the father in the sculpture might be screaming?	max	4 methods 4 fields
The Hammurabi code: bringing forward the original story to show the great importance this statue where a Sun God is telling the king what to write in the law.	Imagine if we bring the feeling of the history behind the sculpture alive by adding light.	max	4 methods 4 fields
A showdown on the Venus sculpture with the western world's definition of beauty and creating a message about the human body a beautiful no matter size or skin color. Nobody should feel ashamed of their body	How can we visualize other definitions of beauty to the sculpture?	max	6 methods 3 fields
Not clearly stated but revealed during the project: A sculpture's expressions in its specific historical context. Middle Age to Renaissance.	How can we create a specific narrative with the interplay of lights and shadows around the plaster cast copy of the Madonna Della Cintola?	middle	5 methods 4 fields
Story of physical slavery turned into a nowadays form of mental slavery. Addiction to smartphone and social media usage and problems of false norms and standard created by the addiction.	To design an installation which will let you think about how addicted we are to our mobile phones.	max	4 methods 3 fields
The story of the natural progression of a girl becoming a woman, then a mother, and then setting her child free in the world.		middle	4 methods 3 fields

Table 1. Analysis of the 13 kick-off projects and the four elements

All students did reach the overall learning goal for the 'Kick-off' project. They made a meaningful project based on their narrative inspired by statues in the Royal Cast Collection. The motivation and engagement was very high during the 13 days of project work, otherwise the students would not have managed to work so hard as they did to accomplish their rather complex and ambitious goals of their projects (see table 1) Integrating the theory of PBL in a 'real' transdisciplinary project seems to be a good solution for students to get the knowledge transformed in a concrete project as a method and structure. Furthermore, the complex challenge raised in each student project motivated them to use and integrate several knowledge areas to formulate a narrative, define a Final Problem Statement, establish design experiments and make a design solution, test and evaluate. In 11 projects knowledge from more than 3 or 4 areas has been used as well as 11 projects have used more than 4 different methods, and they are well integrated in the different steps of the project. The PBL model are in general well used in all project, which also is reflected in the relatively short time students have had for their project work (table 1). 11 Projects have used all steps in the PBL structure and have managed to use in their process as a tool for structuring their project as well as using the 'freedom' it gives to integrate their new knowledge in a transdisciplinary, creative process. Furthermore, the students now are familiar with each other and know their different backgrounds.

5 CONCLUSION AND PERSPECTIVE

It can be concluded that through a 'Kick-off' project based on Problem Based Learning and design the students get knowledge, competence and skills for making a complex project. Furthermore, it was demonstrated that it is a very good basis for understanding the transdisciplinary nature of a complex design field as Lighting Design. All groups have integrated several knowledge areas in their project indicating that they have started to develop technical as well as PBL competences and skills needed for working with a transdisciplinary lighting design approach.
As a follow up on this 'Kick-off' project we would like to follow a semester during all 4 semesters at Lighting Design, analyzing how the students develop their knowledge, skills and competences both within PBL and transdisciplinary design.

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