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Publication date:
2012

Document Version
Publisher's PDF, also known as Version of record

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Teaching for Creativity

Per Boelskifte & Claus Thorp Hansen

1. Background

There is an increasing need in industry and society for developing and implementing solutions that really make a difference. But how do we ensure that our engineering graduates have the right competences regarding innovation? In order to prepare our students, we must formulate open-ended assignments with room for interpretation and creativity. We must also help the students to identify relevant problems and create optimal solutions while ensuring that their assignments are both challenging and manageable.

2. Critical issues related to teaching for creativity

We have identified some critical issues for engineering educators with little or no experience with teaching for creativity:

- How can engineering educators in general develop competences that enable them to propose assignments that challenges and enhances the students' creativity?
- How can they assist and supervise the students during the work process?
- How can they asses the qualities of the process and the proposed solutions?

This paper offers a number of recommendations on how to foster innovation through problem and project based learning. The presentation is based upon our reflection of teaching an undergraduate course on User Oriented Design for the past 10 years.

3. The nature of creativity

In order to arrive at good, innovative engineered solutions we think that two factors are at play:

1. Knowledge of the technical domain.
2. Working methods and approaches:
    - The identification of unsatisfactory conditions/situations, i.e. need.
    - The intent to improve.
    - Imagination of solutions, which might satisfy the need.

We assume the points under *2. Working methods and approaches* are independent of particular technical domains but rather dependent on creativity. What elements make up creativity? What knowledge, skills, and abilities?

- Holistic approach: Actor insights, understanding economic issues….
- Awareness of own personal creative process.
- Knowledge of and ability to apply creative methods, such as *Lateral Thinking, de Bono's 6 thinking hats, and Brainstorming*.
- Ability to co-operate and collaborate

As a consequence of the creativity's nature the educator has to accept that he/she does not know the answers to the students' questions in advance. The teacher does not know the content of the unsatisfactory conditions/situations, and the teacher does not know the good solutions.

4. Formulating a creative assignment

Our intent is to induce 1st semester Design &Innovation students with enthusiasm for creative work whilst also applying and retaining knowledge from subjects that are taught in parallel ensuring reasonable subject integration. In this particular semester the subjects are *Visual Communication, Mechanics and Materials,* and *Product Usability and Design.*

Project formulation:
You are required to develop robust easy to operate solutions for collection, separation and disposal of garbage in the public environment, i.e. streets, squares and/or parks. Your reference environment is municipal Copenhagen.

The project has 3 phases, each with a milestone:
1. Collection and analysis of data.
2. Development of a number of alterative concepts
3. Selecting a concept and further developing it towards a solution.

An assignment that deals with a realistic problem in a known environment challenges the students and seems to work – why? Students tend to like assignments that deals with situations one can identify with – or rather soon identify with. The assignment can be broken down into a number of manageable elements that get integrated in the end of the project. The students are thrown into deep water – but swimming lesson and life-jackets are provided in the form of lectures, project supervision and instructions combined with an effort to integrate aspects form other subjects taught in parallel.

5. Evidence of the effects
What worked well? We divided a complex problem solving project into a number of subprojects.

What worked really well? Visualization- and presentation techniques on a high level were acquired by the students. Only 1 – 2 students, out of classes of 60-65, drop out of the course each year

What went wrong? Group work is challenging. In the beginning supervision of the groups included much work in keeping a good collaborative spirit within the groups. Time we could have used better in supervising issues of creative and academic nature.

Why did it go wrong? In the *premises* we emphasize that the students are thrown into deep water with very few qualifications methodologically and otherwise. We overlooked the importance of assuring the team spirit before embarking on a project with no precisely formulated assignment and indeed no known "correct" solutions. We made an alliance with Learning Lab and in the past 5 years Learning Lab presents the students with a number of modules on studying techniques. These modules are taught by master's students. One module in particular deals with group work and the "contracts" students should make at the onset of an assignment. This has been made obligatory in our course and has cut the number of conflicts and potential conflicts considerably.

How does one asses the students creative ability? The help of good external examiners has been – and still is - invaluable. Also feedback from the students and other stakeholders also ensures good input to our reflection on how to adjust the way we present and teach.

6. Suggestions
In the following a number of suggestions are proposed for the educator's consideration when a creative assignment is formulated in their technical domain. Using the Blue Dot projects as an inspiration, which are

big, innovative student lead projects such as *Ecocar, Robocup, Solar Decathlon, Bryghuset – The brew House* we could consider how to plan a *Mini Blue Dot project*. So how does one plan a 5 ECTS Mini Blue Dot project?

Some important aspects:
- Work with open problem definitions, challenging the "taken for granted "approaches - get the students to think "out of the box"....
- Focus on creativity: Chose an assignment seen from a new perspective with an intent to improve, e.g. waste as a resource.
- Have the students navigate in the unknown creating meaning in the context of the not yet clarified. From unknown–unknown to known–unknown. It is the teacher's role to help the students in creating meaning based on their information collection and observations. It is not the teacher's role to provide meaning.
- The educator does not know the solution for a creative assignment. It is the teacher's role to ask for solution proposals, and to help the students to find fruitful directions into the solution space.
- How to assist and supervise the students during the work process? Strong emphasis on groups and team dynamics. Be present and facilitate. Do not offer too many opinions or too much knowledge. Lead the students to identify problems and solutions themselves.
- How can you assess the qualities of the process? Invite peers of creative domains as "censors".
- How can you assess the qualities of the proposed solutions? Invite experts with insight into the technical domains as "censors".

7. Closing
We hope that this presentation will inspire you to develop new assignments with a creative twist.

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