Technology as Panacea!?
Improvised Skits that Tackle Water Contamination Across the Centuries.

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Extended Abstract for a Hands-on-Session
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Abstract
There is a strong demand for technological innovations as a remedy for ecological destruction and as pathway to poverty eradication. The predominant belief in technological progress is held up through technicians as well as a society wishing for easy technological solutions for complex ecological and social problems (Pongratz and Baier 2015). Taking this into account, this paper outlines the Blue Engineering Course design that promotes socially and ecologically responsible engineering through the use of building blocks, i.e. self-contained study elements. One of the core building blocks addresses the development of water supply and how societies have dealt with this issue over the course of human history. Participants of this building block improvise skits how they would deal with a sudden water pollution with yet an unidentified cause in six different centuries. This helps to facilitate a discussion about society-nature relations as well as power relations.

I Blue Engineering Course at Technische Universität Berlin

This course is the result of a student-driven initiative at Technische Universität Berlin that formed in 2009 (Baier 2013). The very idea that a group of students engages in the creation of a meaningful course not only underlines the shift from teaching to learning, but it shows how seriously this shift can be done. Over the course of four semesters, this student group has developed a course design that disregards any teacher-centered form of education. Instead they have enforced a student-centered approach, so that engineering students acquire the competences to unveil the complex interdependency of their social, political, ecological and economic surroundings. This thorough analysis helps to grasp the personal responsibility as well as the collective responsibility as engineers and humans on micro and macro level (Baier and Pongratz 2013). For the students will also learn to consider the different values, interests and needs within a global perspective as well as within one class(room). The course design encourages democratic decision-making and the corresponding action not only to solve but also to define problems within the course itself and moreover outside of the classroom (Pongratz and Baier 2015).

The first Blue Engineering Course has been conducted by four student-tutors in the winter-semester of 2011/2012 with 25 participants. From the very start it was a course which could be chosen from a list of few possible courses where a certain number of courses from this is compulsory for the master programme of mechanical engineering. This selection of a specific number ‘compulsory’ courses is a widely practiced at German Universities. Therefore the Blue Engineering was credited with 6 ECTS points from the very

beginning. The evaluation and the feedback was overwhelmingly positive so that the student-group offered their course in the next semester as well. This rendered equally positive feedback. Starting from winter-semester 2012/2013 the student-group was granted one lecturer position and two tutor positions in order to ensure a successful further conduction and development of the course.

By now, the course has been conducted 12 times and attracts on average 90 students. 35% of the participants study mechanical engineering and another 35% study industrial engineering where it has been an option of compulsory electives since 2014. The remaining 30% of the participants chose the course as an elective.

Generally speaking, the 14 weeks of a semester are divided into three parts. In the first, tutors conduct a fixed set of building blocks in order to give the participants a concrete idea of what is expected of them later on. In the second part, groups of three to five students conduct already existing building blocks for their fellow students of the course. For this they can choose from list of over 150. In the third part, the students groups conduct a building block which they have developed over the course of the whole semester. The student groups receive continually feedback as well as formative assessment in order to ensure a high quality of the newly developed building blocks.

Building blocks, i.e., self-contained study-elements, are at the core of the Blue Engineering course. They provide clear didactical instructions to facilitate a 60-90 minutes workshop as well as compact, yet multiple perspectives on a complex topic, e.g., ethical codes, recycling, pre-implantation diagnostics, social businesses, gender&diversity, rebound-effect, fracking or cooperatives. Some of these study elements help to thoroughly analyse single technologies while others address social structures and how to change them. Along with the wide variety of topics, every single building block uses a specific set of teaching formats such as case studies, story-telling and station learning. Most building-blocks, however, rely on a specific adaption and new combination of known methods, e.g. learning cascades, advocatus diaboli, triangular method, evaluation sculpture, crime scene investigations and court trials, educational games and challenges. In total, there are now over 150 building blocks (Blue Engineering 2017).

The conduction of an existing building block as well as the conduction and documentation of the newly developed building block are part of the summative assessment. In addition, the students individually keep a learning journal over the whole semester.

The evaluation is presently prepared to be published. For this evaluation, competences that are linked to an education for sustainable development (Haan 2006; 2010) have been adapted as learning outcomes to the specific setting and requirements of the course. They are further designed-down to be used on module level as well as on lesson level (Baier and Meyer 2016). Based on these learning outcomes, a quantitative self-evaluation form has been developed. This self-evaluation of the students takes place at the beginning and at the end of each semester. The results show, that the students perceive themselves as significantly

more competent at the end of course in all tested areas. In addition, there is a qualitative analysis of learning journals taking place that students keep over the course of the semester.

Besides the Blue Engineering Courses at Technische Universität Berlin, there is one course at Technische Universität Hamburg-Harburg since 2012 and one at Hochschule Düsseldorf since summer semester 2016. They are fully conducted by students and student-tutors which even more underlines the student-driven and student-centered approach of the Blue Engineering initiative.

II Building Block "Technology as Panacea!?"

The participants of this hands-on session will participate in a building block that presents how (wo)men have dealt with a sudden pollution of drinking water in different ages of mankind. The building block is called "Technology as Panacea?!" and is a core building block that is conducted each semester. It has been conducted now over 30 times within the course as well as at various (international) workshops to discuss the historic development of technology and its impact on nature and society.

The participants are divided into six groups and each must solve the same problem of sudden drinking water contamination but in another human age, i.e. Stone Age, Roman Empire (Lang and Svenshon 2015) (Schneider 2015), Middle Ages, Industrialization (Wieland 2015) , Present (Dinçkal 2015) and Future. The groups must then depict their solutions through small skits. After each skit there is a short discussion and at the end there is a concluding discussion that aims at pointing out the commonalities and differences between the centuries.

This building block helps to realise that technology increasingly becomes a future cause for possible contaminations of water and nature while creating congruent solutions. Thus, the participants realise how society is shaping technology and how technology is shaped through society in return. This includes notably the spatial and temporal effects of technology. In addition, the participants realize that contamination of water is not something that has happened a long time ago or that will happen in the far future, but that it is happening today even within western states (Carson 2002). Overall, this leads to a deep discussion about society-nature relations (Swyngedouw 2004) and power relations (Swyngedouw, Kaika, and Castro 2002) with respect to water but also within our present society in general (Engels and Schenk 2015). People generally are very touched by the building block for through the theater-play they gain more insights as this is a non-traditional form of learning.

Points for the concluding discussion are:

- What are possible causes for the water pollution? In the Stone Age it’s mostly natural, biological, geographical causes, (wo)men have little influence - this increases constantly over the ages - technology will eventually become a major cause
- What role did the causes play in the presentation? The participants usually focus on the solutions - totally neglecting the causes

- Water as a most basic need of (wo)men - Participants often don't realize/show in their presentations that water is necessary not only for human life, but for all life
- How is water distributed? Who controls the access to water? - Commodification of water in the present, access to water as a "weak" human right, water as a common good
- How to decide water issues? Water and power relations, water and democracy
- Who is affected by the water pollution? In Stone Age the whole nomadic group, in the Middle Ages and Present Age people are differently affected, since certain people have the resources to find their individual solution
- Advancing centralisation of water pumps - there are three central spots for the water supply of Berlin
- Have social solutions been considered? Many times they are totally ignored.
- What are the common points of the found solutions in all ages? Mechanical Filtration, Cooking, Biological/Chemical Treatment, Import of Water, Exodus to another area (in the future scenario even leaving to another planet)...
- What are actual water pollutions which happened in the last decades? Is it a problem elsewhere/outside of Europe? No, pesticides, aluminum production, nuclear power plants, hormones, antidepressants, pain killers

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