Paper 73. “It’s not fair!” - making students engage in sustainability

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Abstract

In this paper, we address the issue of teaching a subject, sustainability, that ideally should permeate the whole engineering education, but at the moment often plays a minor role in the curriculum. Here we discuss the tactics of planning and conducting a sustainability course with the explicit goal of truly engaging the students and making an impact on their thinking. Furthermore, we here present a framework that can be used in course planning and analysis. Finally, we discuss how this framework was used in our sustainability course for Media Technology engineering students at KTH Royal Institute of Technology, and the engagement and resulting change in students perception of sustainability. Moreover, we argue that beyond rethinking the engineer and the engineering education, we also need to rethink our roles as university teachers.

1 Introduction

In this paper, we turn to the subject of teaching a course on sustainability for Media Technology engineers and the central issue of how to engage students in this (to many students) seemingly peripheral matter in their education. Our starting point is that facts are of importance, but we believe that teaching and examining students *only* based on facts is not enough to have a prolonged impact on students’ thinking about these pressing issues. In our opinion, something more and something different is needed in order to engage students. To that end, we as teachers also need to rethink how sustainability can be addressed in engineering education. Hence, we present an analytical framework for designing and analyzing sustainability courses so as to “reach” and engage students in this topic. The framework contains three dimensions that span the tensions between 1) delivering facts versus discussing values, 2) “vanilla” sustainability (every challenge we face constitutes a problem that can be solved) versus “doomsday” sustainability (we face predicaments that cannot be solved), and 3) sustainability as relating to the specific engineering discipline in question versus sustainability on a societal (and personal) level.

The analytical framework presented here, has been created based on the process of planning and giving a course on sustainability for Media Technology engineering students at KTH Royal Institute of Technology. Furthermore, using empirical data from students’ hand-ins, we exemplify the outcome of using the framework based on experiences from this particular course in terms of the changes we perceived in students’ attitudes to sustainability issues. We furthermore argue that in order to rethink the engineer, we also need to consider the related issues of rethinking the aim of our courses, and rethinking our roles as university teachers.

2 Sustainability Requirements at KTH

KTH Royal Institute of Technology in Stockholm, Sweden, has around 20 Master of Science in Engineering programmes and has offered a Master of Science in Media Technology since 1999[1]. The education is primarily directed towards educating engineerings students towards a labor market around traditional mass media (publishing, film production, graphics, TV, radio) and new media industries (human-computer interaction, interaction design and in general anything related to the Internet). Some of the alumni work with purchasing, developing and operating technical solutions, production systems or information management systems, other work in consulting firms or start their own businesses.

There are several "requirements" that students must fulfill for a Master of Science in Engineering according to the Swedish Higher Education Act. Three specific requirements can be related to sustainability (emphasis added):

"For a Master of Science in Engineering the student shall

- *demonstrate the ability to* ***develop and design products, processes and systems while taking into account*** *the circumstances and needs of individuals and the targets for* ***economically, socially and ecologically sustainable development*** *set by the community*
- *demonstrate the ability to* ***make assessments informed by*** *relevant disciplinary,* ***social and ethical aspects*** *as well as awareness of ethical aspects of research and development work*
- ***demonstrate insight into the possibilities and limitations of technology, its role in society and the responsibility of the individual for how it is used, including*** *both* ***social and economic aspects and also environmental*** *and occupational health and safety* ***considerations****, and demonstrate the ability to identify the need for further knowledge and undertake"*

As part of a central KTH initiative, it was decided in 2011 that all engineering programmes at KTH should go from words to action and ensure that all engineering students had relevant and sufficient knowledge regarding sustainability. A minimum requirement was that each engineering programme should *at least* have a 7.5 credit course[2] relating to sustainability, although integrating sustainability into several or many courses in a programme would be preferable. At KTH there is a growing concensus about the importance of sustainability/sustainable development as a topic in engineering education and KTH has since 2011 developed a range of initiatives in the area, including a (Swedish-language) "toolbox" with different kinds of practical resources for teachers who are interested education in sustainable development[3].

The three requirements with relevance to sustainability (above) were concretized into eight "learning goals" (much like a checklist), and all programmes that did not have relevant courses were ordered to amend the situation either by developing such a course or by outsourcing it to a department that could develop and give a course about sustainability. At the department of Media Technology and Interaction Design, we decided to develop and give the course ourselves. There were several advantages of keeping the course in-house, for example the fact that we know our students and their interests as well as central subjects in the program better than anyone else. Also, there were in-house

[1] See further http://www.kth.se/en/studies/programmes/swedish-programmes/msc/media-technology-300-credits-1.63132

[2] Corresponding to 1/4 of a semester.

[3] See further http://www.kth.se/om/miljo-hallbar-utveckling/utbildning-miljo-hallbar-utveckling/verktygslada

faculty interest in the topic and a course would thus constitute an opportunity for ongoing development of our own knowledge in the area.

Still, the question remained: when it comes down to it, how can we engage our students in this (to many students) seemingly peripheral matter in their education? What can you actually *do* in one single course to make a difference and to aligns students' interests and concerns with present and future sustainability challenges? The course in question constitutes a quarter of the course load during a single term, and as the engineering education is 10 terms long, the course corresponds to no more than 2.5% of the total course load of the whole education. The challenge we faced can be formulated as follows: how can a sustainability perspective be presented and take root among the students in question, taking into account that parts of such a perspective contradicts many students' near-deterministic belief in ongoing technological progress - a worldview that is affirmed and perhaps even "built into the walls" of *any* school of computer science (c.f. "Moore's law" (Moore, 2006))? The answer we came up with was to overwhelm them with information and and evidence to the contrary and force them to at least reconsider that which they most often take for granted.

3 On Tensions - An Inspirational Framework

The can be seen as a difficult task to develop a new course (about sustainability) that presents challenges when integrated into the core "program ethos" (Edvardsson Stiwne and Roxå 2009) of an engineering program. Such a course could possibly even be perceived to "chafe" not so much against other specific courses, as against an implicit-but-established dominant worldview (or "paradigm" (Kuhn 1962)) of exponential technological progress and a complacent leave-it-to-technology-to-solve-all-problems-attitude[4].

The easy way out - for both teachers and students - would be to develop and to deliver a facts-based course that might inspire the minority of students already interested in or concerned about the issues at hand, but that would constitute "just another course" (quickly forgotten) by the majority of the students. We[5] were however not satisfied with that. We wanted to make a difference, up to and including "fostering 'metanoia', i.e. a shift of mindset" and 'Eureka' moments (Lozano 2010) in some of the students taking the course. In committing to this goal, it was not only the content of the course that needed to change - as teachers we also had to rethink our roles and our relation to the subject matter being taught. In this context, we to some extent were (or became) "teacher-activists" (Busse et. al. 2013, Hauser et. al. 2013). This statement might also help readers understand our interest in creating something more than just barely fulfilling the minimum requirements for an engineering programme.

The act of moving away from a mainstream fact-based course have forced us to construe alternatives to such courses, as well as to analyze our own positions as teachers, concerned citizens and activists. The result of this effort is the framework proposed below. The framework consists of three dimensions that have been with us since the inception of planning the course. The actual structuring of these concerns in terms of a framework is however something that was only explicitly formulated and developed in the course of planning and writing this paper.

[4] For an engineering-based pushback against such a worldview, see Huesemann and Huesemann (2011).

[5] While this paper is written by the two teachers who gave the course in question, it should be mentioned that Jorge Zapico's knowledge and work effort was crucial for planning and developing the course.

3.1 Dimension 1 - Deliver facts vs. discuss values

As mentioned above, we were not interested in only delivering a facts-based course based on lectures, readings and seminars. Such courses are not seldomly assessed through (only) a written test at the end of the course and would correspond to the traditional, non-threatening role of casting the university teacher as someone who "retreats" into his/her domain knowledge and who just "delivers the facts" with seemingly little emotional concern or investment in the issues at hand. In this case, "the facts" are in fact multifaceted, complex, interdependent, and demand action - although the question of appropriate action is open to interpretation and to discussions. We were furthermore afraid that students could easily feel there was a large gap between (global) sustainability challenges and the specific area of their own studies, i.e. "as a media technology engineer, I really can't do much in my professional role about CO2 emissions and climate change".

While facts are important, we felt that preoccupying ourselves *only* with facts in a course such as this can create a problematic distance to the problem at hand. A student reaction could easily be "yes, it's a serious problem, but it is primarily *someone else's* problem" (some other kind of engineer, people with political or economic power, the rich, the poor, society at large, the US, China etc.).

The alternative to only delivering facts is to also bring values into the course and to discuss these. This calls for more interactive forms of education, i.e. an increased proportion of seminar-to-lectures, smaller seminar groups and/or utilizing parts of lectures answer questions or to actually actively ask questions and get input from students. Mulder et. al. (2010) have identified nine "main challenges" in Engineering Education in Sustainable Development and one of these challenges is the very question treated here, i.e. "how to teach normative content in an academic context?".

Another "main challenge" formulated by Mulder et. al. (2010) was to "practice what you preach". While Mulder et. al. referred to issues such as initiating environmental projects and greening the campus, our interpretation of this challenge was more close up and personal. It was in fact a little frightening to realize that if we expect our students to "open up" and discuss values and issues that are close to their hearts (including uncertainty and doubt), we as teachers would probably have to go first and show the way in terms of self-disclosure. This partly went against our instincts, since we oftentimes concentrate on "left-brain" logical, analytical, objective aspects in our roles as lecturers at a technical university. But how is it possible to create a considerate, trustful climate in a seminar room if we as teachers are not willing to "lead from the front"? For example, how do you create a secure environment where it is possible to open up and discuss sensitive topics, including being prepared to encounter students who dare to frankly talk about their fears concerning the possibility of a future of personal hardships, or a possibly bleak future for life on planet Earth? These are tasks that we as university teachers are not necessarily particularly prepared for, again pointing at the need to rethink not just the engineer's role and contribution in society, but also our roles as teachers of future engineers. While discussing values "raises the stakes" in the classroom, the yield can also become so much larger in terms of engaging students in issues that are of importance to them.

3.2 Dimension 2 - "vanilla sustainability" vs. "doomsday sustainability"

Probably the largest "innovation" in comparison to other course on sustainability or sustainable development is our emphasis on a tension between what we have chosen to call "vanilla" vs "doomsday" sustainability. We have consciously chosen these two "exaggerated" terms so as to make our point clearer and easier to perceive.

Vanilla sustainability is the kind of effortless sustainability where our current problems can be solved without any major changes to our political and economic system, to our current levels of affluence or

to our (car-dependent) commuting habits or (airborne) vacation plans. Vanilla sustainability points at a future where ***mitigation*** strategies "won" and where changes made within the current "regime" (i.e. something close to a Business-As-Usual scenario) actually managed to avert the buildup of too-large concentrations of CO2/greenhouse gases in the atmosphere and humanity thus managed to avert catastrophic climate change.

Vanilla sustainability textbooks, no matter how bleak when the problems we are facing are described, will always end with one or more "happy chapters" in which proposed actions are in fact taken and humanity thus manages to avert the bleak scenarios described in the first (larger) part the book. Vanilla sustainability courses similarly describe solutions to our current problems as possible, viable and perhaps even inevitable; not seldom with high hopes tied to new technologies[6], to an increased quality in terms of political and/or corporate decision-making and governance, to increased involvement and pressure from the general population etc. A problem with vanilla sustainability is that it reinforces the idea that "we're in control" and "someone else is working on this" (and that someone will or at least *should* fix it, so it's not *my* problem).

Doomsday sustainability instead points at the folly of believing that our current civilization is sustainable (i.e. will continue for a long time). Problems of particular concern are many, for example the fact that current economic models are based on exponentially increasing throughput of (non-renewable) energy and mineral resources into our industrial system, on a wide diversity of important environmental data points and measurements that for the most part point in the wrong direction, on the presence of much talk but the absence of effective political action in the environmental area (e.g. multi-lateral negotiations with paltry outcomes) and so on. Doomsday sustainability thus instead points at a future where ***adaptation*** strategies are necessary, i.e. we will *not* manage to avert catastrophic climate change and we instead will have to learn to live with the uncertainty of altered weather patterns, decreased agricultural output, an increase in extreme weather events and a decrease in human affluence and welfare etc. Doomsday sustainability has no "happy chapter" and runs the risk of shocking, depressing or even paralyzing students (see further below), but can however paradoxically also be liberating, since it takes students' worries seriously instead of glossing over fundamental problems. This perspective could also work as a call to more *fundamental* rather than *superficial* action.

A milder take on "Doomsday sustainability" is expressed in the title and the contents of a recent high-profile conference (CHI 2012) "best paper" by Tomlinson et. al. (2012), "*Collapse informatics: Augmenting the sustainability & ICT4D[7] discourse in HCI[8]*", *as well as in other more recent publications such as for example Tomlinson. et. al. (2013), "What if sustainability doesn't work out*" and Pargman et. al. (2013), "*HCI in a world of limitations: Addressing the social resilience of computing*". These papers are all in one way or another inspired by archaeologist Joseph Tainter's (1988) notion of collapse as a long-term (decades, centuries) process of social "decomplexification" that eventually afflict all mature civilizations that have expanded to a point where they cannot both maintain the upkeep of historical and current complexity *and* pay the costs of solving new problems (i.e. increasing complexity even further) in relation to available natural and other resources.

[6] For example geoengineering, Carbon Capture and Storage (CCS), nuclear or fusion energy, the hydrogen economy, hydraulic fracking (fossil gas), electric cars, increased efficiency of heating and cooling etc.

[7] ICT4D stands for Information and Communication Technologies (ICT) for Development, i.e. working with underserved or marginalized populations primarily (but not exclusively) in developing countries.

[8] HCI stands for Human-Computer Interaction.

3.3 Dimension 3 - ICT and media vs. personal and societal sustainability

When opening up the classroom for discussions about "everything between heaven and earth" (in the form of the two dimensions outlined above), it can become difficult to make delimitations between the purported topic of the course and more general (and perhaps more personal) sustainability implications. What is the relationship between on the one hand general issues pertaining to sustainability, for example personal behaviors, collective practices, societal infrastructure and global challenges, and on the other hand the specific issues having to do with the topic of the course; ICT and media in relation to sustainability?

Let us assume that the course content (lectures, readings, discussions) can be divided into two parts; one part referring to sustainability issues that can be explicitly related to ICT[9] and the other part referring to sustainability issues with a non-ICT focus. What is a desirable (or acceptable) balance between these two parts? How is it possible to delimit non-ICT-related topics and discussions once that particular "can of worms" has been opened?

In our case, after a (non-ICT) "sustainability basics" introduction to the topic, we gently directed the class towards topics and discussions by carefully choosing ICT-related readings, formulating ICT-related seminar questions etc., while at the same time taking care not to curtail students' questions that were falling outside (relatively) narrow topical borders. As to the question of how to balance ICT- and non-ICT-related topics, we have no straightforward answer to that question. Since we have chosen to foreground the issue of *engaging* our students in the topic at hand (sustainability), we have implicitly had to bracket any ideas of ours about conveying a specific set of knowledge and skills in the course.

A related problem is that while there are many books about sustainability, including textbooks about sustainability for engineering students (Mulder 2006), there are no suitable textbooks about sustainability specifically for engineering students studying ICT and/or media. This puts an added burden on teachers to find relevant readings for topically adapted course such as ours.

Yet another problem is to think outside the box. Just as "to the man with a hammer, everything looks like a nail", to the (wo)man studying an ICT programme, everything will tend to look like a problem that can be solved by designing a "fix" in the form of a computer program. How do we get our students to think about low-tech or perhaps even no-tech solutions to hard problems or to wicked problems. What if designing a (complex, complicated) computer system sometimes is the wrong way to go and (for example) some old-fashioned social control instead would be an easier (better?) way to "solve" a problem (O'Day et. al. 1996, Baumer and Silberman, 2011)? What if it turns out that burglars are *not* deterred by yet another technological system, but instead rather are deterred by evidence of neighborhood cohesion (Erete 2013)? We would like our students to think about problems with as few prejudices as possible, including the prejudice that every problem in the world by necessity has (only) a technological/high-tech solution.

4 Student Engagement in Practice

The main course components were lectures/guest lectures, discussion seminars with smaller student groups and a home exam. Furthermore, the course ended with a panel discussion where different perspectives and positions on sustainability (economic, environmental and social) were discussed.

[9] Or, in the case of other courses, equivalent core issues in other engineering programmes.

The discussion seminars were much appreciated by the students and their role as one of the strengths of the course were stressed in a majority of the course evaluation forms. Before each seminar, students got an assignment which usually consisted of reading one or more papers but sometimes of listening to a podcast or watching a TED-talk (video). The variety of materials (reading, listening and watching) was furthermore much appreciated by the students. As part of the seminar preparations, each student had to prepare a question, to be handed in in advance, and with the possibility of discussing it with the whole group during the seminar. For some seminars, students also had to write a short reflection on the topic of that particular seminar, and these documents were read by other students and commented upon through using a social annotation system (Pargman et. al. 2013). These preparations encouraged/forced students to prepare for the seminars and made them more engaged in the subject:

"The preparation for the seminars were very good as well, because I tried to get deeper and deeper into the sustainability topic."

At the very first seminar, all students presented themselves and described their relationship to sustainability. Some of the students expressed some concern for the environment and acted on that concern for example by sorting their garbage, but less often by buying organic food since students "can't afford it". However, noticeably, many students had no relationship at all with the issues taught in the course. Furthermore, many admitted that the only reason for showing up to the seminars and lectures was because the course was mandatory and high attendance was explicitly coupled to increased chances of higher grades.

In the end of the course, many more students were engaged in the subject and when students discussed their images of the future during the very last seminar, several issues concerning students' changed perception of sustainability were brought up. Some students expressed that they had gone from doubting climate change to showing a higher awareness and concern for the state of the planet and the future of humankind. One student even expressed with some astonishment, that she had found organic food in the refrigerator, and realized that she had started to buy more organic food during the course.

The hand-ins show that the students were struggling to reconcile the possibilities of addressing sustainability with the help of ICT and media technologies to the overall issues of sustainability and climate change on a societal level. However, the hand-ins also suggests that the students progressed in terms of developing a critical mindset, and many students were subsequently able to formulate creative, critical and deeply insightful questions concerning all levels of sustainability; technological, personal and societal. Some examples of student-submitted seminar questions were:

"Are you willing to make the necessary sacrifices for a sustainable future? Do you think that enough people are? How does other people's sacrifices affect your will to make sacrifices?"

"How can we make a transition and use less energy without inhibiting the development of new technology?"

How do you change a consumption-based economy into a non-consumption based economy?

"In terms of solving the sustainability issue, is ICT doing more good than bad? Are there not more important things for our society to focus on, or does ICT enable us to better focus on these things?"

Are ICT systems going to save our civilization or bring it down?

Several other students expressed deep concern, and described how they, especially at about the middle of the course had felt almost depressed:

"The course can give a feeling of hopelessness."

Before discussing this statement, let us just point out that a statement such as this appears to signify that the course indeed was successful in making students engage in sustainability, since it is only possible to feel hopelessness after you are been emotionally affected, i.e. engaged. The statement is furthermore interesting in relation to the above described framework as it raises the issue of whether we should present students with a 'doomsday' sustainability perspective at all? Or, to what extent and degree should this be done, and how can we also counteract the feelings of despair that this can entail? McMahon et. al. (2010) encountered the same issue in their course on sustainable development at the University of Limerick[10] and their conclusion was that "*positive elements must be the focus of all teaching in the SD* [Sustainable Development] *realm so students feel empowered and capable of bringing about behavior change in themselves*". That might be so, but does that mean we should necessarily shy away from hard questions and from perspectives that might be "difficult to digest"? One student stated after having taken our course that:

"I was interested in marketing and stuff like that before the course, but now I feel like doing something that is more beneficial to humanity."

Would we see such a statement if we would have chosen to focus only on positive, up-beat elements of sustainable development? That is an interesting and important issue that can and should be further discussed (see further "discussion" below). Another student spontaneously exclaimed that "It's not fair!" in relation to the prospects of a life that is substantially curtailed in terms of material possessions compared to that of her parents' generation. Yet another student wrote in the course evaluation that we as teachers should "*make sure that everybody reaches the "acceptance"-part of the "trauma-pattern*"[11]. During the last part of the course, many students however expressed that they felt that it was a relief to be able to discuss "dark futures" and that there was finally room for action even though (or because) the prospect of life as we know it could be considered bleaker after the course compared to before.

5 The End of the World as We Know It

While planning the course, we believed it would be exceedingly hard to convincingly present an alternative to a dominant worldview based on technological progress and economic growth. We were much influenced by US high school teacher Dan Allen's (2010) testimony of trying to discuss the topic of resource-depletion with American 17 and 18-year olds:

"*Upon hearing my 'pessimistic' news, many of my students immediately begin to formulate ideas to 'save us.' With optimism as their default setting, and perhaps unimpressed by my sobering evidence, they cheerily refuse to see our energy issue as what it is: an unsolvable predicament requiring adaptation to a new lower-energy reality. They want to see it as a solvable problem. And in the bold spirit of our industrial fore-bearers* [...] *they seek to find some technological way out of this energy jam. Lifestyle change is simply not a thinkable option.*"

We therefore presented a course module that was supposed to jolt the students' convictions (see above) after about a third of the course and were genuinely surprised by the students' receptiveness to ideas of sustainability, of limitations and of scarcity in general. We thus realized we might have forced

[10] "*some students* [...] *felt that the module was very depressing and that the majority of information was tending towards the 'doomsday scenario'*" (McMahon et. al. 2010).

[11] The student here referred to Kübler-Ross' (1969) model of "five stages of grief"; 1) denial, 2) anger, 3) bargaining, 4) depression and 5) acceptance.

some already-open doors, and that we perhaps had conveyed a view that was too negative in our attempts to "shake the students up" and convince them of the fact that things perhaps were *not* ok today sustainability-wise. We later came to ask ourselves exactly where students' readiness to hear out alternatives to the dominant societal narrative came from? The best answer we can provide is that these students for the most part were between 22 and 24 years of age, and that the financial crisis of 2007-2008 and its lingering effects (the 2008-2012 global recession and the European sovereign-debt crisis) at that point had been with us for no less than five years, i.e. for a substantial part of these students' adult lives. Our interpretation is that what is considered "normal" to someone one or a few decades older than our students (i.e. prosperity and economic growth) might *not* be considered normal to students in their low-to-mid 20's today, and that they therefore are much more open to, or indeed are hungry for alternative interpretations of the state of the world than for example their parents' generation.

It was also clear through listening to seminar discussions and through reading the hand-ins and course evaluations that a majority of the students had indeed been engaged by the course (and subsequently changed their perception of sustainability). The attitude in general went from mild scepticism to a more concerned stance. There was also a marked change in the nature and the quality of the hand-ins, where later hand-ins to a higher degree were more comprehensive, more reflective and more critical. The course has however only been given once, and we have not had the possibility to follow the students further in their education, so we have no clear evidence that this change will linger.

The engineering role, and the engineering education is already under reconsideration in many ways. Employability of engineering students from a perspective of generic skills, including empathy, has for example been researched and discussed by Rasoal (2012). It has been suggested that this particular trait can be further developable through group coaching and problem-based learning (PBL) (Rasoal 2012), an educational method also promoted for teaching normative subjects such as sustainability to engineering students (Lemkowitz, 2001). We argue that we as teachers need to address a holistic view of the sustainability topic, consciously confronting and navigating among tensions between the three dimensions of the framework outlined above. We also argue that we need to engage the student's in such a way that it leaves them with a lasting impression and a critical mindset that they can make use of both throughout the engineering education and later, in their professional lives. This not only implies that we need to rethink the engineer and rethink the aim and design of our courses, but it also means that we need to rethink our role as engineering educators. In some ways we need to act as role models, opening up for discussions, disclosing our own world-views and coaching the students into a critical, yet open mindset.

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