AT ODDS WITH A WORLDVIEW—TEACHING LIMITS AT A TECHNICAL UNIVERSITY

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This article takes as its starting point the staggering challenges humanity is now facing and will continue to face during the remainder of the 21st century. During the past century, our civilization has experienced an explosion in ingenuity, knowledge, and creativity, but it has also shaped the world in such a way that some researchers suggest we have left the Holocene and are now living in a new geological era called the Anthropocene. Ours is a finite planet, and human-induced (anthropogenic) developments have pushed the earth system beyond safe boundaries when it comes to biochemical flows, climate change, and biosphere integrity [1]. Perhaps even more alarming, we are still in the dark in terms of understanding those limits (e.g., the concentration of aerosols in the atmosphere, chemical pollution in the form of heavy metals, toxic substances, endocrine disruptors), while the output from our industrial system continues to pollute and alter the atmosphere, the biosphere, and the oceans. We are simultaneously reaching limits to what we can harvest from the Earth in terms of non-renewable resources like minerals and oil [2]. These large-scale developments are capping the possibilities for what can be developed and built in the future, including computational systems and devices. Computing itself will be bounded by the limits and the challenges and changes. Since they will affect all of us, we believe they should be addressed in *Interactions*

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and by the HCI and interaction design community in general.

We teach an introductory course in sustainability and ICT (information and communication technology) to first-year media technology engineering master's students at KTH Royal Institute of Technology in Stockholm. We are planning to teach the fifth cycle (the course debuted in 2012) in parallel with the launch of a new master's level track, Sustainable Information Society. Many of our students major in HCI; they will do research or work as practitioners of usability and user experience for decades to come. In this article, we will first elaborate on two approaches to addressing and teaching engineering (computing) students about the environmental and other challenges presented above. We call these approaches *vanilla* and *strong* sustainability. We will reflect on our experiences in meeting these challenges head on and teaching our students about sustainability and computing from a perspective that emphasizes strong sustainability.

VANILLA VERSUS STRONG SUSTAINABILITY

In planning, teaching, and evaluating our course on sustainability and ICT, and having taken courses on sustainability ourselves, we are aware of the various stances a teacher can choose when communicating and teaching the topic [3]. In many cases, especially in engineering education, the foremost stance is to present problems in such a way that they become possible to solve through picking low-hanging fruit in the form of energy efficiency, incremental technological innovations, or by applying human ingenuity. If those solutions seem inadequate, another option is the omnipresent catch-all of hoping for technological breakthroughs (the hydrogen economy, electric cars and smart grids, breeder reactors, carbon capture and storage, geoengineering, space migration, and so on). *All proposed solutions are habitually placed within an imagined future social, political, and economic system that will allow us to continue to live as we do today and where the developmental trajectory*

does not differ significantly from what we have experienced during the past 100 years. This imagined future ties into the dominant narrative that we live at the best of times and that economic and technological progress has solved, and will continue to solve, any problems we are and will be encountering.

We have previously defined this stance as *vanilla sustainability* [4], a perspective in which mitigation strategies are employed to avoid calamity and where the problems might be severe, but will somehow still always be manageable. It could be that this perspective is especially attractive to students and professionals in the information and computing sciences because it both defines the problem of sustainability as 1) manageable and relatively easy to solve and 2) as a problem that *someone else* will solve (someone working with transportation, energy, pollution, planning, policy—anyone but me!). Nothing could be further from the truth. Living in a world of absolute limits will affect us all, and we all have to pitch in, both in our professional roles and as private citizens.

In between "This is easy" (vanilla sustainability) and "This is too hard," we carve out a stance we choose to call *strong sustainability*. Strong sustainability does not shy away from taking seriously predicaments such as climate change, planetary boundaries, future scarcity of nonrenewable resources (fossil energy, minerals), and the consequent challenges this scarcity will pose for our economic system. This perspective is tough to take on, and for some, provocative in challenging the sustainability (or indeed the possibility) of everyone striving to take on Western lifestyles, or even for Westerners to maintain their current lifestyles.

In earlier writing we have called this stance *doomsday sustainability* [4], not because it implies we are approaching the end of the world, but because it implies the end of the world *as we know it*—our social and economic systems will have to change in countless major ways to address the insurmountable predicaments in front of us. This stance to teaching sustainability embraces uncertainty and addresses issues that might be unavoidable, such as climate change and resource depletion, including their global and long-term consequences. This perspective, in turn, requires adaptation strategies and presents visions of the future that to some extent can be perceived as bleak and challenging, and where computing might not play a central role.

TEACHING LIMITS

In university courses there is often a gap between the syllabus and the actual course. Since vanilla sustainability is the norm at our university and in our society, we believe that most syllabi tend toward bland, uncontroversial formulations either because these formulations represent an accurate description of the (bland) course contents, or because it makes for fewer problems for teachers, like us, who complement or fill their courses up with more radical course contents. There are thus several levels we can use to describe the goals we have with teaching our course.

The most basic level is to ascertain that the course taught corresponds, or corresponds well enough, to the course that was promised. Our experience is that students, at least at an engineering university, seldom complain about the actual ("political" dimensions of) lecture contents, the choice of literature, and so on, but that administrative gaffes of various kinds can become the topic of complaints (e.g., a problem with the attendance list, a last-minute change in the instructions for a seminar, delays in grading). Also, we have found it exceedingly rare that students compare the course given with the course promised (as described by the syllabus) and complain about discrepancies. Assuring that the course runs smoothly and fulfills the most basic requirements is important, but our goals with the course are definitely higher than just delivering what has been promised in official documents.

The next level is to move our students to care, at least a little, about sustainability and other issues we raise in the course. We have written about the challenge of engaging media and computer science students in what many of them (at least before the course) regard as "a topic of little relevance to their future careers" [4]. We have concluded that it is crucial to find ways to connect and bridge the distance between students' perceptions of their own profession and sustainability as a topic.

We do, however, believe that it is *easier* to move students with course content that takes strong rather than vanilla sustainability as the starting point, and by not avoiding discussions of difficult topics. Such discussions can bridge the gap between our current affluent Western lifestyles and the nagging feeling that our way of life is, in fact, patently unsustainable (probably within the lifespans of our 20-something students and especially so if scaled up globally). Such discussions also acknowledge that sustainability is *the* challenge of the 21st century, and what we mean by affecting our students can be handily summed up in a hypothetical student's sudden realization that "...oh my god, does that mean that *I personally* have to…?". This realization constitutes a direct challenge to many students' worldviews. As an example, and despite the fact that the course hardly touches on the topic of food, it seems this is an area where many feel that they can make a difference. We know that several students felt the course was the straw that broke the camel's back to make them go vegetarian. It should be said, though, that we don't know if this is a temporary decision from which they later retreat (say, three or six months after the course is over). Some students experience a wake-up call like this as a mixed blessing:

The revelations have made me more anxious about life and our future. It's good stuff but I would probably be more happy without it. Not knowing is bliss. (2015 student answer to a questionnaire that was distributed a third of the way into the course)

Yet another level of describing our goals for teaching the course is to go beyond the individual here and now. We want our course and the lessons and perspectives we offer our students to be something they internalize and carry with them during the remainder of their education, as well as into their private and professional lives. By affecting our students' worldviews, we as teachers challenge the business-as-usual worldview of our technical university through our students' own actions. We notice it when some students take our lessons to heart, and their other teachers complain to us that students' questioning attitudes about sustainability constitute a "distraction" in their courses. One student complained about the cognitive dissonance of taking hard environmental limits into account while simultaneously taking a course at the Stockholm School

of Economics, where she worked on a task to increase the revenue of an airline company by optimizing the pricing of seats. It is of course harder to know if the alternative worldview we present has an impact in their lives after they leave the university, but there are encouraging signs that it might.

Ultimately, the goal for us is to teach students a perspective that they will not only practice in their own lives, but that will also support them to act as change agents, affecting and persuading others to work toward the endeavor of building a more sustainable society in both their private and professional lives. We do, however, have to prepare them for this effort, since the strong sustainability perspective will be at odds with other, less forceful sustainability perspectives. In the best of all possible worlds, we would like them to act as insiders who are part of the dominant culture, but who at the same time try to change the system they are part of from within. In sum, we want them to balance between a complacent reasonableness and G.B. Shaw's "Maxims for Revolutionists":

The reasonable [person] *adapts himself to the world: The unreasonable one persists in trying to adapt the world to himself. Therefore all progress depends on the unreasonable* [person].

CHALLENGING A WORLDVIEW

We have outlined a stance called strong sustainability, which we have chosen to adopt in our first-year master's level course about ICT and sustainability. By adopting this stance, we have also chosen to make life a little more difficult for both ourselves and our students. Many of our students tell us that they felt alarmed and unnerved in particular during the beginning of the course, when lectures focus on the predicaments described in the introduction. However, we believe it is important to dare to confront the hard facts of the state of the world and discuss them. In that way we avoid slipping into the socially constructed denial so often sought when we are faced with disturbing issues [5].

Strong sustainability and its implications for the future professional and private lives of our students constitute a direct challenge to most students' worldviews. This also constitutes a challenge to the predominant ethos at a technical university in general, and a school of computing science and communication in particular. So how has this gone down with the students? We have to say we are surprised how ready our students have been to listen to what we have to say. But we have experienced the whole gamut of reactions, from polite rejection to students craving to hear more, including a request to continue the seminars after the course had ended.

While planning the course and giving the course for the first time, we were very nervous. What if our students wouldn't accept the perspective we were presenting? What if our experiences would come to mimic those of high school chemistry teacher Dan Allen:

Upon hearing my "pessimistic" news, many of my students immediately begin to formulate ideas to "save us." With optimism as their default setting… they want to see it as a solvable problem … They seek to find some technological way out of this energy jam. Lifestyle change is simply not a thinkable option [6].

To counter any and all possible objections, we had massive amounts of additional information for all eventualities at hand during the first cycle of the course. Afterward, we realized that the students were much more receptive to the ideas than we had anticipated. We later asked ourselves where the students' openness came from, and our hypothesis nowadays is that it comes from living through the 2008 European debt crisis. That event and its aftermath now constitute a major part of any 20-something university student's life, and what is considered normal to their parents' generation (e.g., economic growth, employment, and continued prosperity) is not necessarily something that young adults born in the 1990s will assume.

These students are the ones we entrust with the task of creating the sustainable society that we have failed to create. Adopting a vanilla sustainability stance could never have been an option for us since we believe that computing and HCI will be severely affected by coming changes, and that we are as responsible for addressing the problems as any other discipline. Perhaps we are even more responsible than many disciplines, since computing has become such an important part of the infrastructure in society at large.

We argue that HCI researchers and practitioners are well equipped to be change agents due to the baked-in multidisciplinarity of HCI and the bridging capacity it can encapsulate. We are already in between—in between technology and use, between system and human, between the boardroom and the shop floor. We can also be between sustainability and development, bringing the ideas of a more sustainable society into the development of technology.

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ENDNOTES

1. Steffen, W., Richardson, K., Rockström, J., Cornell, S.E., Fetzer, I., Bennett, E.M., Biggs, R., Carpenter, S.R., de Vries, W., and de Wit, C.A.. Planetary boundaries: Guiding human development on a changing planet. *Science 347*, (2015). DOI: 10.1126/science.1259855
2. Aleklett, K. *Peeking at Peak Oil*. Springer Science & Business Media, 2012.
3. Nardi, B. Designing for the future: but which one? *Interactions 23*, 1 (2016), 26–33.
4. Pargman, D. and Eriksson, E. 'It's not fair!': Making students engage in sustainability. *Proc. of Engineering Education for Sustainable Development 2013*.
5. Norgaard, K.M. *Living in Denial: Climate Change, Emotions, and Everyday Life*. MIT Press, 2011.
6. Allen, D. The infinite energy machine and the myth of green energy; http://www.resilience.org/stories/2010-03-03/infinite-energy-machine-and-myth-green-energy

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