Exploring Inner Transition: Expanding Computing for Sustainability

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ABSTRACT

In this position paper we ask what constitutes reasonable personal and collective responses to the predicaments we face as individuals, as societies and globally in the age of escalating sustainability crises. We in particular take our teaching about sustainability and computing as a starting point as well as an end point for a discussion about what happened when we started to focus also on our students’ emotional responses in the face of receiving troubling news about sustainability, about limits and about the future. Moreover, we also use this intervention as a point of entry to a discussion about how this changed not only our students, but also ourselves as teachers, as colleagues and as human beings.

KEYWORDS

inner transition, paradigm, sustainability, limits

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1 ON THE MESS WE’RE IN

We have at this point taught a course, “Sustainability and Media Technology”, for engineering students at KTH Royal Institute of Technology (Stockholm, Sweden) 12 times between 2012 and 2022. The course is compulsory for third-year students studying the engineering programme in Media Technology and it has also been voluntary, recommended or compulsory for various groups of masters-level students [17]. The number of students taking the course has increased over time but has generally over the last few years hovered between 75 and 95 students per year. We have reflected on our teaching and have written a relatively large number of papers about how to integrate sustainability into (computer) education, as well as about other aspects of our teaching [14–18, 52, 53].

Many sustainability-related events have happened during this period of time. In terms of science and policy; new IPCC reports are regularly released, the UN organise their annual Climate Change Conferences (COP), including the 2015 conference where the Paris Agreement was signed [1], the Sustainable Development Goals were launched 2015\footnote{See https://www.un.org/sustainabledevelopment/sustainable-development-goals/}, Johan Rockström and others formulated the “Carbon Law” [59] and the Exponential Roadmap Initiative released their Exponential Roadmap [20] with the slogan “Scaling 36 solutions to halve emissions by 2030”. WWF continues to release their “Living Planet Report” [77] every second year, where almost everything stays the same or gets worse and almost nothing ever gets better. Other notable events are that the International Energy Agency (OECD’s energy agency IEA) have stopped mumbling and are now more explicit than ever when they say that there cannot be any more investments in new oil fields, while France’s president Macron recently stated that the era of abundance has come to an end. Besides many pseudo-events that seem to be important to some people but that simultaneously seem to make little difference in the larger whole (for example in terms of decreased global CO2 emissions), we have also seen the rise of environmental activist movements that organise youths and others across the globe (Greta Thunberg and Fridays For Futures) and that encourages dramatic and playful civil disobedience (Extinction Rebellion, XR). All this while the planet itself is wrecked by an increasing number of natural disasters that nowadays occur at a frequency and at an amplitude that by any and all measures have stopped being “natural”.

The obstacles to transitioning to a more sustainable society and a good life within planetary boundaries [57, 66] are enormous. The inertia is crippling and change seems nigh impossible. We here point out three obstacles to change of which the first is path-dependency. Modern societies are based on an infrastructure that runs on fossil fuels and the energy infrastructure is rooted in decisions made generations ago. In fact, “our oil-fed energy supply chains have developed over a 145-year-old growth cycle [and] We are dependent on this multitrillion dollar global infrastructure as much as we are dependent on the petroleum that feeds [it]”\footnote{As this was written in 2006, we can soon add another 20 years to the build-up of the global infrastructure around oil (oil wells, oil pipelines, refineries, oil tankers, tanker trucks, gas stations and a billion or more internal combustion engines).} [70, p. 24]. Historical transitions from one energy source to another have taken several decades or even centuries [23, 65]. “Changes in the world of energy are measured not in months, not in years, but often in decades. The abrupt transition from whale oil to kerosene [in the mid-19th century] took less than two decades” [70, p. 22].

Phasing out fossil fuels in a period of a few decades would make the shift to war-time economies during the second world war seem like a walk in the park, since between 80-85% of current global primary energy consists of fossil energy sources (oil, coal, gas). The shock of reducing European dependency and consumption of Russian gas and oil after the invasion of Ukraine (spring 2022) hints at the magnitude of the challenges ahead of us, and to say that decreased energy use would change our lives radically is by now
self-evident (and the term “radically” is surely an understatement). To take but one example: it is far from clear how modern industrial fossil-dependent agriculture could be reshaped fundamentally (and in just a few decades!) while still managing to produce food for 8 billion people.

We here run into the second obstacle and that is that we suffer from a crisis of imagination [29]. While we obviously need to transition to a sustainable society (a good life within planetary boundaries), we don’t really know what that means and we have a hard time imagining (or agreeing on) what that implies. Most images that come to mind (of less, of restraining or refraining or of sufficiency) are not very appealing to most people in society. This is particularly true for the images of the future that are created by popular culture, where there seems to be very little that is not either variations of business-as-usual, techno-utopias/techno-dystopias or bleak post-collapse imaginaries (for example the streaming media shows “The handmaid’s tale”, “The walking dead” or “The last of us”).

This brings us to the third obstacle (which is intimately tied to or perhaps even an extension of the second obstacle), that we misunderstand change and what actually needs to be done. Even when we know what doesn’t work, what to aim for and what needs to be done (or we think that we know), we still seem to get stuck at the level of “fiddling with parameters” [48]. It often happens that we misunderstand what the real problem is and try to push for change – but inadvertently pushing with all our might in the wrong direction [47, p. 1]. Politicians and decision-makers (and mostly everyone else too) take for granted what already is, and then try to improve a flawed model, system or society. Management guru Peter Drucker has captured the futility of aiming for improvements when you don’t understand what the (real) problem is, e.g. “Efficiency is concerned with doing things right. Effectiveness is doing the right things” [10]. We are too often concerned with doing what we already do, but slightly “better” (e.g. doing things right by having another go at fiddling with the parameters), when we would do better to first ponder what the things worth doing are. "The things worth doing" are captured in the three lowest and most important levels of Donella Meadows’ list of places to intervene in a system [47], namely 1) to question, discuss and define “the goals of the system”, 2) to point out anomalies, breakdowns and failures in “the mindset or paradigm out of which the system […] arises” (e.g. its’ goals, power structure, rules, culture) and 3) to stay flexible and unattached to any particular paradigm in order to have “the power to transcend paradigms”.

So having lined out a litany of problems and challenges, what are we then to do as university teachers, as researchers and as human beings? Besides expectations and formal criteria that comes “from above”, our professional responsibilities require us to execute what higher-ups have decided and what the organisation itself demands for its smooth running. But what additional responsibilities do we voluntarily take upon ourselves out of love for our students and a heartfelt wish to help make them human beings rather than someone else’s tool? How can we plant a seed in our students that can develop into an urge to do their bit in making the world a better place?

Daniel on becoming human: I have taught our students about sustainability for more than 10 years and have surely scared some (or many) a lot on an annual basis as a side effect of feeling the compulsion of convincing them that This. Is. Really. Important. Five years ago we entertained the thought that we perhaps had a responsibility also for how our students felt, but we found it hard to accept that responsibility and harder yet to know what to actually do should we accept it. In 2021 we changed our minds and I applied for a sliver of money from the internal pedagogical funds to work with “Sustainability and the emotionally competent engineer”. We thought we were doing it to help the students, but did not realise how this would change us. How it would change me. An invited guest3 gave a talk that moved some of the students to tears, but also left them dazed and happy since his no-nonsense talk was so brutally honest that it had a cleansing effect as it washed away all our defences and excuses. My colleague had a heart-to-heart conversation with some of the most affected students afterwards when I happened to pass by, listen in and make a joke. My joke was misplaced and it broke the spell and the exchange of honest thoughts and deeply felt emotions. I immediately felt that I had done damage to the conversation and to something beautiful and unusual that had been germinating in that place and at that particular moment. Reflecting on this, I understood that I had made the joke to deflect and to avoid handling the strong emotions (such as pain and sorrow) that the talk had awakened both in myself and in the students. Having a raw and honest conversation with my students about something that was Really Important to them and to me was not something I was prepared for even after having been a teacher for the better part of 20 years. And this despite the fact that I was the main teacher, that I had applied for the money to run this side activity and that I had personally convinced this particular guest to visit us after I heard him give the same talk a month earlier. Still I could not handle the raw emotions that his talk awakened in an emotionally mature way. I then and there came to realise how much I still have to learn. When we later evaluated the whole intervention and the activities together with the students, I wrote a note on a post-it: “I need to become a human and not just a teacher for my students”.

2 SO WHAT DOES THIS MEAN (TO US AND TO THE WORLD)?

So what is the mindset out of which the current flawed system arises and that Meadows suggests we should question (and change)? And how do we figure out what the right things to do are? And how do paradigms shift?

Kuhn [34] has written about how scientific paradigms shift, and his answer is that they first change slowly and then more quickly, but perhaps not quicker than the pace at which proponents of the old paradigm die off. But we are here less interested in documenting how paradigms can or do shift, and more interested in finding a reasonable, helpful and practical answer that can guide us in taking the next step as researchers and teachers (and then yet another step). We suggest that a precondition to finding good answers is to ask better questions, and to help others ask better questions – instead of coming up with tired knee-jerk answers that have proved to be inadequate again and again. Meadows [47, p. 1] wrote that:

3The guest in question was Dougald Hine and he has since published the book “At Work in the Ruins: Finding Our Place in the Time of Science, Climate Change, Pandemics and All the Other Emergencies” (2023).
“Growth has costs as well as benefits, and we typically don’t count the costs — among which are poverty and hunger, environmental destruction, etc. — the whole list of problems we are trying to solve with growth! What is needed is much slower growth, much different kinds of growth, and in some cases no growth or negative growth. The world’s leaders are correctly fixated on economic growth as the answer to virtually all problems, but they’re pushing with all their might in the wrong direction.”

The legacy of the adaptations that Covid forced on higher education in 2020 is an example of pushing with all our might in the wrong direction. Some faculty members at our university thought that education in the age of Covid (lectures and seminars mediated by Zoom) were a great boost to distance education and that such education is just as good as campus-based education — because the students managed to attain the same average grades in 2020 as the year before. This reasoning is wrong for so many reasons, of which a few are:

- Grades say very little about learning and less so during an emergency when many teachers became more lenient in applying grading criteria so as not to needlessly hurt the future career opportunities of “Covid cohorts”.
- Students who were cooped up in their tiny student rooms were robbed of years of student life and the student experience and they (for obvious reasons) didn’t feel very good and quit their education and/or suffered from mental health problems at a greater rate.
- Last but not least, if lectures and seminars are “just as good” over Zoom as when teachers and students meet face to face in a classroom on campus, this says very little about the qualities of Zoom education and much more about how we mismanage the opportunities that campus-based physical co-presence has to offer us as social human beings. Instead of stating that Zoom education is “just as good”, we should ask why campus-based education is so bad that it can easily be replaced by online education.

We need to learn how to ask better questions. We unfortunately see the same inadequate answers to the current hot-topic issue of students’ use of AI in higher education, e.g. of the threat that students will or already have started to use ChatGPT to produce texts or computer code and present it as their own. Knee-jerk reactions range from allowing students to use ChatGPT freely (in the same way they can use calculators to do advanced and not-so-advanced mathematics), or alternatively to try to increase control by using AI to catch students using AI, have more written exams (with no external aids), or adding an oral component to the exam (in an attempt to figure out if the text was written by the student in question or not). None of this is what we want to do as teachers or what we want other teachers to spend their time on doing. We readily admit that we here don’t know exactly what the right answer is, but we do believe that virtual reality visionary Jaron Lanier is onto something when he expresses his unhappiness about how digital technologies are used, and suggests that the solution is “to double down on being human”.

While ChatGPT can write adequate (or better) texts and code, ChatGPT can not answer questions that are uniquely important to humans, nor is ChatGPT a suitable discussion partner for a 23-year old computer science student who worries that the next version of ChatGPT will rob him of his dream job as a programmer. This is something that AI pioneer Joseph Weizenbaum was onto almost 50 years ago [75] and tech critic Neil Postman was onto more than 30 years ago, although Postman couldn’t imagine the “the computer itself” (rather than student with a master’s degree in computer science) would become king:

“the computer has a nature as well. True, it is only a machine but a machine designed to manipulate and generate information. That is what computers do, and therefore they have an agenda and an unmistakable message. The message is that through more and more information, more conveniently packaged, more swiftly delivered, we will find solutions to our problems. And so all the brilliant young men and women, believing this, create ingenious things for the computer to do, hoping that in this way we will become wiser and more decent and more noble. In a world populated by people who believe that through more and more information, paradise is attainable, the computer scientist is king. But I maintain that all of this is a monumental and dangerous waste of human talent and energy. Imagine what might be accomplished if this talent and energy were turned to philosophy, to theology, to the arts, to imaginative literature, or to education? Who knows what we could learn from such people—perhaps why there are wars, and hunger, and homelessness, and mental illness, and anger”.

So what are those better questions we should ask - and that we should train our students to ask? Surely they have something to do with the uniquely human potential to embrace and navigate the uncertainty of living in a complex world, instead of searching for fixed, algorithmic or formulaic answers and increased control. We here suggest that letting go of control and of first acknowledging and then embracing uncertainty is the new paradigm in an age that is increasingly characterised by wicked [58] and super-wicked [38] problems.

This is a paradigm that, schooled as we are in the mores of modernity, easily can make us uneasy. It is easy for our minds to refuse or to push such thoughts away. What does “embracing uncertainty” even mean? It’s impossible! It’s above my pay grade! It’s somebody else’s problem! Modernity schools engineering students in solving problems, thereby becoming masters of the universe. Some strange problems “at the margins” have however exhibited a curious ability to resist solutions [2, 5, 50, 55, 68, 69]. But what if the problems we now face (wicked problems and their ilk) can not once-and-for-all be “solved”. This is in line with Greer’s [22] distinction between “problems” (which have solutions) and “predicaments” (where all possible responses fail to “solve” the problem, but some responses are better or worse than others). In line with Greer, the current

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crisis of crises\textsuperscript{6} that humanity now faces implies that there is a real possibility that sustainability [e.g. mitigation] “won’t work out” [72]. At the same time we however suggest that the alternative paradigm is lurking in the shadows, or possibly hiding in plain sight “in the interstices of structure, in liminality; at the edge of structure, in marginality; and from beneath structure, in inferiority” [73, p. 128].

Elina on inner transition: What was the path that led me onto inner transition? Was it the collaboration with professional activists, or was it the interplay with students who reacted emotionally to the admittedly scary facts we teach in our course? Was it my personal family life, fraught with illness and death? Or was it that every time I felt I understood “the sustainability problem” better, I only had to take a step back to see it from another angle, and that being an angle that pointed towards (yet) deeper changes. Perhaps you could call my reading of books and listening to podcasts willy-nilly, as if I followed my gut as to what to explore next. And I began to questions many deeply held beliefs, questioning the language we use [35], seeing that the dualism of our modern culture went deep and back into ancient history [36] and that up until 300 years ago, societal organisation had been a kaleidoscope of different possibilities [21]. Opening myself to all the grief of lost possibilities, and the gratitude of being alive at this time of “the great turning” [41], I started to see my relationship to the world differently. Shifting my inner compass, questioning my work [6], questioning myself. It was weird, but I realised that I myself have to change, in order to change the world — and it felt ridiculously insufficient and insurmountably hard.

3 NEW PARADIGMS

So what if the new paradigm is already here, pre-emergent, lying underneath, bubbling and cooking and sometimes showing itself in the cracks of the old paradigm? There are at least traces of it, for instance, or perhaps especially, within the LIMITS community. The first trace is to actually seriously consider limits, even though this can be done within the western modern business-as-usual paradigm as well, albeit with difficulty. However, deeply embracing a perspective of limits will challenge and potentially poke holes in the ideas of how the world is constructed. At the Computing within Limits workshops, authors have for example questioned the idea of evermore, and instead considered sufficiency [27]. Similarly the capitalist system is under interrogation through explorations of counternarratives of green capitalism [8] and the call for degrowth computing [67]. Several papers in different ways engage with permaculture, for example [40], [13], and [24]. Others have explored the need for considering psychological limits [33] or other types of ethics, including other-than-human ethics [9]. The new paradigm can also be seen in many of the patterns that Schneider and his colleagues have explored with the LIMITS community [62]. Perhaps the new paradigm is most apparent in the work of Mann et al. [44] on Regenerative Computing - calling for a more hopeful position in relation to the future and embracing a more ecological worldview, questioning the focus on limits from the beginning. Equally, Houston et al. also questions the emphasis on limits, arguing that “thinking in terms of limits alone can constrain our thought as we seek transformative change to better futures. We turn instead to ideas of abundance and practices of care, since they offer new tropes to think with but also new modes of concrete, everyday practice” [30]. (This discussion of limits vs abundance is very much in line with the arguments of prominent degrowth thinker Giorgos Kallis [31].)

We don’t think that the new paradigm is in full bloom, even within the Limits community, and it is hard to describe a pre-emergent paradigm using language of a paradigm that is passing [7]. Magnason gives poignant examples of how “We use old ways of thinking to understand new ways of thinking” [42, p. 69] and how “Most people think only in terms of the paths and concepts offered within a given era” [42, p. 75]. He points out that the phenomenon of “ocean acidification” is one of the most significant events in the changing constitution of planet Earth during the last 30 to 50 million years, yet:

“If we examine the science behind ocean acidification and consider how many of Earth’s inhabitants are reliant on the seas’ health, we might wonder whether the full meaning of ‘ocean acidification’ in 2019 is similarly weak as the word ‘holocaust’ was in 1930 compared to its meaning in 1960” [42, p. 77].

Our current paradigm is a paradigm that fosters dualism and that objectifies and tries to conceptualise everything (and here we, like others before us, are aware of the fact that we are speaking from a western, white, middle-class, privileged position, and that there are other worldviews and positions that contain more of the plurality we need (c.f. [19]). The dominant paradigm does not acknowledge relations and our dependency on the rich web of life around us [37], nor does it not take into account our responsibility or reciprocity to all living beings [32]. This is a calling for another way of being in the world, what some have chosen to call Earth’s jurisprudence, under which the work for rights of nature and the movement towards ecocide law [26] represent early vanguards into legal theory and new laws [71]. Slightly in opposition to Mann and colleagues [44], we do however think this will be a shift that will be fraught with “negative” emotions like fear and sorrow, and that acknowledging and working through these emotions is an absolute necessity [56]. Instead of placing all our hope in hope itself, we need “active hope”, starting with gratitude, embracing but also drawing power from sorrow at the state of the world and only then, with a clearer idea of what needs to be done, determinedly going forward [41]. This is a path of self reflection, of questioning long held beliefs, also about ourselves, and of using the power that comes from daring to consider that things might not work out, so as to find the strength and conviction to carry on and do whatever we believe is right, and whatever we can in the service of making the world a better place [6], even if and when the odds do not seem to be in our favour. And still it can be hard to figure out what one (as a computer scientist) can and should do.

Elina on coming home: At the end of 2020, I wondered if I did enough. Sure, I was teaching (very meaningful), and researching sustainability (will not lead to a Nobel Prize), but what about my private life? I had changed my everyday practices so that I had a fairly small carbon footprint, and now and then I went to climate demonstrations. But was that enough? I mean, when do I stop and glue myself to a road as a statement? On a whim I applied to take

\textsuperscript{6}See https://metacrisis.org
part in an online training of sorts, over a weekend, paying for it by myself, thinking that perhaps I will be inspired and find meaningful ways of acting in my free time. It felt as if I was sneaking into this group of people who I imagined were all full-fledged activists, that did things for real, things that mattered. However, I was contacted a week before the training and asked if I would like to be a storyteller and share my story during the training. The instructions I got were: the story should be personal and it should say something about how and why I have ended up where I am, as a researcher at the university.

I told my story the second day of the training, in the evening after a full day of online discussions and reflections. There was a (virtual) fire burning and even though we were all in a video-conference call, it felt as if the listeners were sitting close to me, listening intently and compassionately. And as I told my story, I realised I was already home. My work was my activism. Nothing I could do privately would ever compare to the leverage I have as a researcher and teacher at a technical university. My superpower was my job. I should dig where I stand.

4 HOW TO DIG WHERE YOU STAND (AS A COMPUTING RESEARCHER)

So what does it mean and how do we as computing (within limits) researchers “dig where we stand”? A precondition to finding good answers is (again) to ask better questions and to take into account that individuals (also within the Computing within Limits community) can understand the challenges we face very differently. In order to “dig where we stand”, we first need to understand where we stand, and Paul Chefurka has suggested a model, a “ladder of awareness”, with five stages of progressively deeper understanding of the unfolding global crisis of crises:

- **Stage 1: Dead asleep.** There are no major or fundamental problems facing humanity and the problems we face are thus minor and fixable. This is not a position that is compatible with a Computing within Limits perspective.
- **Stage 2: Awareness of one fundamental problem.** People at this stage perceive and can be very vocal about (and perhaps engaged in activism connected to) one major problem and Chefurka suggests climate change, Peak Oil, biodiversity loss, run-away capitalism, economic instability or sociopolitical injustice as examples of such problems.
- **Stage 3: Awareness of many problems.** The list of problems (above) can be made much longer and people who are aware of the existence of several/many problems think about how to prioritise and concentrate on “the most important problem” in terms of degree and impact.
- **Stage 4: Awareness of the interconnections between the many problems.** Realising that problems are connected leads to the realisation that solving one problem can aggravate another problem, and a transition from thinking about specific problems to thinking about predicaments.
- **Stage 5: Awareness that the predicament encompasses all aspects of life.** This includes everything we do, our relationships to each other and our treatment of the biosphere and the physical planet. Entertaining the idea that there are (once-and-for-all) “solutions” becomes a waste of effort and there is a risk that depression can set in.

The authors of this paper can recognise in themselves a journey through these different stages, and we leave it to the reader to contemplate where they themselves are. While Stage 5 could be a position that is hard to reconcile with a Computing within Limits perspective, we would argue that it can be possible with some effort. Paul Chefurka describes how reaching Stage 5 in his experience often leads to either engaging with localisation (for example by joining the Transition Network) or choosing an inner path of self-development.

To “dig where you stand”, you first need to understand what problems need to be solved, and due to their interconnectedness, general strategies become more interesting than specific solutions. In a widely distributed Computing within Limits “foundational article” that was published in Communications of the ACM [51], the authors propose three key principles that are consistent with Computing within Limits:

1. **Question (economic) growth.**
2. **Consider models of scarcity.**
3. **Reduce energy and material consumption (e.g. consider the whole economic system and strive towards reducing resource throughput).**

These three key principles are very much in line with degrowth (sometimes called post-growth), e.g. the “transition to a society that [...] is based on a much smaller throughput of energy and resources, that deepen democracy and guarantees a good life and social justice for all, and that does not depend on continuous expansion” [61, p. 4, our emphasis].

But what more specifically is the relevance of this to computer scientists? Aren’t these questions that experts in sustainability, economics, political science and other relevant disciplines should work with - rather than computer scientists? But in the 21st century, sustainability is no longer a special interest that can be left to particular “experts” (if it ever was), but rather something that all professions need to consider and work towards. Samuel Mann [43] argues that every student should graduate with relevant skills and the knowledge to become a sustainable practitioner in his or her chosen fields (no matter what that field is).

What then is the task of a sustainable computer scientist? It is our belief that computer scientists (and probably most other professions) aggrandise their own importance and role. Someone who works with Human-Computer Interaction (HCI) can easily believe he is a “renaissance man” since HCI acts in the intersection of computer systems, design and people. An article that presents seven HCI grand challenges (Stephanidis 2019) include “human-technology symbiosis” (“inject some AI into even the most common products [creating] smart ecosystems, comprising smart devices, services, materials, and environments that cooperate in a seamless and invisible manner”) and helping fix problems having to do with “social organization and democracy” (e.g. to with appropriate technological support “better address contemporary fundamental problems such as energy use, pollution, climate change, immigration, and poverty”). Shneiderman et al. [63] enumerate 16 grand

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7 “Dig where you stand” is a Swedish proverb signifying that you should start your work where you currently are, e.g. to “begin at home”.
8 See http://www.paulchefurka.ca/LadderOfAwareness.html
9 See https://transitionnetwork.org
challenges for HCI researchers including redesigning the (presumably US) healthcare system, developing new business models and encouraging reflection, calmness, and mindfulness. Not to be outdone, Meyer and Norman [49, p. 16] suggest that one of eleven challenges for Human-Centered Design is to “address the major societal issues facing the world, including the sustainable development goals specified by the United Nations, which seek to “address the global challenges we face, including those related to poverty, inequality, climate, environmental degradation, prosperity, and peace and justice” (UN Sustainable Development Goals)."

Restricting ourselves to HCI and sustainability, a recent literature review [25] indicates that out of 71 papers that self-identify as “Sustainable HCI” and that were published between 2010 and 2019, only 51 papers could be matched to specific Sustainable Development Goals (SDGs). Out of these 51 papers (that were published at more than 20 different HCI-related venues over the course of a decade), more than 80% were concerned with one specific goal, namely SDG 12, “Responsible consumption and production”, so it seems HCI is not (yet) doing a great job of saving people and planet. We should also add that we are in fact quite critical of using the SDGs as a touchstone for sustainability (including a suspiciousness about their compatibility with “eco-modernism” and “green growth” and thus also of pushing with all our might in the wrong direction [47, p. 1] - towards more economic growth).

An alternative, more humble approach is to do what professor of computer science Steve Easterbrook did 15 years ago when he offered his services and his knowledge of computer science and software engineering to climate scientists. These climate scientists developed complex computational models for understanding climate change, but with little knowledge of what computer science and software engineering could bring to the task [12]. In Easterbrook’s short workshop paper “Climate Change: A Grand Software Challenge” [11] he quickly narrows down the problem at hand:

“Climate change is likely to be the defining issue of the 21st century. [...] Unfortunately, the scale of the systems involved makes the problem hard to understand, and hard to solve. [...] To address them, researchers, engineers, policymakers, and educators from many different disciplines need to come to the table and ask what they can contribute. [...] Software plays a major role [and] provides the critical infrastructure that supports the scientific study of climate change [...] We need to solve hard problems to improve the way that society finds, assesses, and uses knowledge to support collective decision-making. In this paper, we explore the role of the software community in addressing these challenges, and the potential for software infrastructure to bridge the gaps between scientific disciplines, policymakers, the media, and public opinion.”

Besides the three key principles of Computing within Limits listed above [51], we would, with inspiration from Easterbrook, and in line with Mann-Bates Sustainable HCI Rubric Stage 5 [45], like to propose a fourth key principle, namely:

(4) Apply computing to solve real-world sustainability problems.

We thus propose that more computer scientists should ask how they can be of service to others more often, including to be of service to researchers from other disciplines who are busy attempting to solve real-world sustainability problems. This also at least partly means rejecting the idea of inventing the next big thing [39], say for example better AI in the (in our mind vain) hope that it could (maybe, perhaps, sometimes, somewhere) be used to further sustainability goals [74]. To be in the service of others could also mean supporting activists. An example of this is Silberman, who in his paper at the first workshop on Computing within Limits [64], offered “six pieces of advice for computing researchers aiming to do work that contributes substantively to broader efforts to change our society in response to our growing awareness of the limits to, and consequences of, economic growth.” These pieces of advice included principles such as “Draw on research beyond computing to develop a rich understanding of the relevant ecological and social dynamics, risks, and opportunities” (principle #2) and “Focus on the social and ecological benefits, risks, and consequences of real sociotechnical-ecological practices, not on novel technologies per se” (principle #6). Baumer and Silberman [4] have previously also reflected on when and where technological interventions might not be appropriate (e.g. entertaining the idea that developing AI to solve sustainability challenges might not be a good idea since the chance of said AI being used in ways that are detrimental to sustainability surely is at least an order of magnitude higher).

5 BEING OF SERVICE TO OTHERS

So what does a computer scientist need to read, to think or to do to be of service to others? We suggest that while deeper knowledge of computer science is desirable, such knowledge is not primary. In line with our proposed Computing within Limits key principle #4, “Apply computing to solve real-world sustainability problems”, Silberman [64] proposed that computing researchers should be “embedded and engaged”:

“Build real systems for use by people working in their real contexts [...] to grapple with the specific consequences, risks, and opportunities posed by global change to their particularly socially and ecologically situated communities and livelihoods.”

Both Easterbrook and Silberman have chosen to be of service to others by building a real system for real people in real contexts (Silberman) or by more unconditionally making their skills and knowledge available to other researchers who were working on real-world sustainability problems (Easterbrook).

But where does the impetus to adopt such a perspective come from in the first place? We suggest that rather than read up on computer science, it is more important for a scholar in Computing within Limits to read up on that which provokes, that which widens mental horizons and that which challenges and has the potential to change the [current] mindset or paradigm out of which the [current] system [...] arises” [47]. A goal to strive for as a community is thus to focus on helping to give birth to a paradigm that is a more promising and more suitable starting point for working with the challenges that humanity faces in the 21st century, what Mann et al. [46] call a Transformation Mindset. While Mann et al. exemplify how the Transformation Mindset analyses the process of
reviewing papers for a scientific conference, it does not actually say anything about us as persons, or how one ends up acquiring such a mindset. Elina’s story on inner transition (above) is an example of one person’s path to acquiring such a mindset, and perhaps we need to openly share more of these stories to support each other and to prepare the way for a shift of paradigms?

If we accept the idea that change can happen when a tipping point is passed, we must also accept the idea that it is possible to move closer and closer to a tipping point without receiving any discernible signs that that is the case, but, that each step that takes us closer to the tipping point still is supremely important. “When a line is crossed and something new starts to happen, the change may appear to come out of nowhere. Discontinuous change can be triggered by quite small events. When you’re close to a threshold, one tiny step can take you over it” [41, p. 187]. Doing what feels right in your heart is thus always worth doing — even if your actions don’t lead to any discernible results (in the short run). This obviously does not mean that you should disconnect rational thinking and mindlessly act on any and all of your feelings, but rather that (strong) feelings constitute a starting point for deeper reflection that calls for integrating heart and mind!

6 GOING DEEPER

An interesting example of this shift (from knowledge and hard facts to relevant skills and a changed mindset) is the work that has gone into defining the “Inner Development Goals”11 (IDGs) with the support of both academic and corporate parts12. The IDG report13 states that “there is a blind spot in our efforts to create a sustainable global society”, since we talk far more about what changes are needed in the world than we talk about how to build relevant skills among actors who are in a position to help make these changes in the world happen. The report therefore states that “the purpose of the Inner Development Goals project is to draw attention to the need to support development of abilities, skills and other inner qualities for people and organizations involved in efforts to contribute to a more sustainable global society” (The IDG report, p. 3, our emphasis). A worldwide survey in 2021 resulted in 861 answers about “What abilities, skills and qualities [...] are essential to develop, individually and collectively, in order to get us significantly closer to fulfilling the UN Sustainable Development Goals?”. A second survey (with 813 answers) asked respondents to rank which skills/qualities they deemed most important, and the surveys resulted in a list of 23 essential skills and qualities that have been included in the IDG framework. These “essential skills and qualities” have been organised into a framework with five main categories (see Table 1), and could be treated as an example of what we should strive to cultivate in ourselves as well as in our students.

We here suggest that cultivating and developing the skills and qualities listed in the IDG framework is one example of how to lower the threshold of embracing a new perspective and a new mindset. This would be the mindset that makes working with the challenges that humanity faces in the 21st century, and learning to be of service to others come naturally.

Table 1: Inner Development Goals categories and examples

<table>
<thead>
<tr>
<th>#</th>
<th>Category</th>
<th>Examples of skills and qualities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Being (relationship to self)</td>
<td>Self-awareness, openness and learning mindset</td>
</tr>
<tr>
<td>2</td>
<td>Thinking (cognitive skills)</td>
<td>Complexity awareness, critical thinking</td>
</tr>
<tr>
<td>3</td>
<td>Relating (caring for others and the world)</td>
<td>Connectedness, empathy and compassion</td>
</tr>
<tr>
<td>4</td>
<td>Collaborating (social skills)</td>
<td>Co-creation skills, communication skills</td>
</tr>
<tr>
<td>5</td>
<td>Acting (driving change)</td>
<td>Courage, perseverance</td>
</tr>
</tbody>
</table>

We here do not mean to say that the Inner Development Goals are the only or the best way to work towards shifting your own or someone else’s mindset (and there will surely also be a lot of individual variation), but the IDGs constitute a pedagogical example of the link between achieving “outer goals” (in the world) and working with and encouraging ourselves and our students to develop “inner goals” (inside ourselves). There are many other ways of learning to be of service to others [76], and some of the thinking that specifically influenced Elina can be found in her story on inner transition (above). As an overarching principle, this paper is not a check-list to follow, but rather a movement, inviting us to turn the gaze back and see that we are the system, and that this realisation gives us agency to first change ourselves and then change the world [60].

So what could we potentially do within computing, to help each other shift to a new mindset? First and foremost we believe that we need to address inner transition more openly, and collaboratively. Again, we do not mean to say that this is the silver bullet, but are only trying to put into words experiences that are hard to communicate, because we do not really have a language to smoothly do so within our domain and within the current paradigm. Inner transition for us contains (at least) two different parts. The first is to become aware of, and be able to handle feelings and emotional states that might arise when taking in the state of the world. In some regards this could be considered to be reactive, and it is exemplified by what we did in our sustainability course when we focused our attention on our students’ eco-anxiety [17]. The second part is to become proactive and to mentally prepare oneself for what might come to pass. To be able to better handle uncertainty and complexity in a world that is becoming less predictable and modern and more uncertain and complex. This implies becoming more aware of what kind of human you are (as in Daniel’s story on becoming human), and here we need to learn from other fields of expertise.

To better understand yourself is to also be better able to hold space for the new paradigm to be born and to, as Scharmer puts it [60], create a safe container or a flourishing social field. This includes becoming a better listener. It might help to go to therapy, to read up on human development, to address past trauma in our

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11See https://www.innerdevelopmentgoals.org
12See https://www.innerdevelopmentgoals.org/about
13“Inner Development Goals: Transformational Skills for Sustainable Development”, see https://www.innerdevelopmentgoals.org/framework
own lives or to engage in mindfulness, yoga or breathing exercises [54]. Challenging oneself could also be helpful, for example through performance (theatre, storytelling, improv or stand-up), or by starting a new hobby — and by really reflecting on what happens when one does so. It could also be by (preferably together with others), work through the exercises that are offered in books like Active Hope [41] and Hospicing Modernity [7]. Our advice is to continue to experiment and play with whatever aspect of the new paradigm you can see in the cracks of the old paradigm and to explore it by whatever means you have, with whatever person you find and in whatever situation you can. Connect and share with others so that that which is pre-emergent, lying underneath, bubbling and cooking can emerge from the cracks and spread like wildfire, or, in the words of Jeremey Lent:

“Just as trees in a healthy forest communicate with and fortify each other through their underground mycorrhizal network, each of us can be most effective in transformative change when we connect with the existing network of life-affirming groups already operating around us” [36, p. 378].

7 OUR SHOVEL

To dig where you stand you need a good shovel.

Daniel’s story on letting go: I have always had a large need for control. Delegating and trusting others has been hard and “quality control” (checking up on others) is my second nature. But less can be accomplished if I have to be on top of every single thing I am involved in. So I’ve slowly come to realise that letting go of control can be good, but it’s a long way from understanding that “in your head” to feeling it “in your heart”. From thinking it to living it. Long-ago courses in improvisational theatre were fun but challenging (and at times slightly uncomfortable), but they didn’t fundamentally change me. But working with our students’ feelings of eco-anxiety did make a difference. As did a course in stand-up comedy and then performing in front of live audiences. But what broke the floodgates open was a flash of insight when I saw an image of the “Chaordic System” (see Figure 1 below). I’ve spent a lot of time at the intersection of “order” and “control”, and that’s a great place to be for performing routine tasks that do not change. But you have to let go of the handrail if you want to explore that which is new, challenging and exciting, and to open yourself up to discovering the unexpected. The fact that it was a circus manager who gave a mini-lectures about the model strengthened the credibility by 1000% - because you obviously can’t “be in control” while developing a new circus act, but you definitely want to be in control when you set up the safety net for tonight’s show… So I realised I have to develop the capacity to move between creative chaos, order and control. You want to open up the classroom to (some) creative chaos and to the unexpected, because it will be more fun and generative both for your students and for yourself. Otherwise you might as well replace the oh-so-predictable teacher with a recording of last year’s Zoom lecture (or with an AI). And, now is the time to double down on being human and to embrace uncertainty, unpredictability and the unknown.

We personally continue to use our courses as spaces for experimentation, and as spaces where we can help our students (and ourselves) become better human beings. In this we have been inspired by “Art of Hosting: Harvesting Conversations that matter” [14]. At a primary level, Art of Hosting might seem to be nothing more than a rich toolbox of methods for planning and performing co-creation events, and some of the more well-known tools are Open Space and World Café. But Art of Hosting also blends a suite of powerful conversational processes that stand on a foundation, an ethos or philosophy of sorts that encompasses radical decentralisation, radical democracy and an invitation to harness the collective intelligence of a group by distributing and handing over as much control as possible to the participants themselves. Interestingly, one of the most central tenets of Art of Hosting is “the four-fold practice”, often described as a responsibility to, to the best of your ability, 1) host yourself [15], 2) be hosted, 3) host others and 4) be part of a hosting community. Inner transition is thus already built into the four-fold practice, because you cannot host yourself if you don’t (get to) know yourself. And going deeper, we suggest that Art of Hosting is part of the new paradigm. Art of Hosting to us represents an understanding that we need to let go of certainty and to open ourselves up to the unknown, the living, the wild and that which we cannot control. To open up to and to prepare for the future that wants to be born [60]. Art of Hosting was a personal tipping point for both of us (and the Chaordic System came to us through Art of Hosting).

While we have already included some Art of Hosting practices such as storytelling and circle practice [3] in our courses [17], our aim is to level up the use of Art of Hosting as a vehicle for change in our education. We are currently planning a new course, “Leading Complex Change Processes”, but the course is (despite its name) to a large part built on Art of Hosting practices, and the course will use Art of Hosting to teach students how to use Art of Hosting (and we use Art of Hosting to plan the course, so there’s currently a lot of hosting going around). It is possible to ask what this has to do with computing, and yes, we are deviating from a pure computing path (but haven’t we for a long time?). But we are in a fortunate position and can afford to be brave and use the power that comes

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14Art of Hosting is a highly effective way of harnessing the collective wisdom and self-organising capacity of groups of any size, see further http://artofohosting.org  
15To “host yourself” means that you as a participant have a responsibility to be present, that is “to show up, to not have distraction, to be prepared, to be clear about the need and to understand what your personal contribution can be [...] For meetings to have deep results, every person in the room should be fully present” (from The Art of Hosting & Harvesting Conversations that Matter workbook, available online at: https://leadinginhumanservices.weebly.com/2017-harvest.html)
with having high job security and of being almost impossible to fire (famous last words) to do what our guts tell us and what our hearts believe the world needs more of.

8 CHECKING-OUT

We have explored an ephemeral oxymoron in this paper, a paradigm whose shape can only be partly apprehended since it both does and does not exist yet. That which we write about is not yet fully formed, or is perhaps formed but can not be wholly captured in words (yet). At least it can not be wholly captured in words by us, here. It does not matter how much we conceptualise it, dress it up in words and eloquently attempt to describe it, because to fully grasp it, it needs to be felt individually as full human beings - and not just in our heads, but also in our hearts and in our whole bodies. But if we never conceptualise it, clothe it in words and talk about it, then how can we learn more about it and how can we help it be born? We have been trying to capture some of what we have learned during the last couple of years in this unconventional, self-reflexive academic paper. To do so we have also made use of storytelling, a central tenet of Art of Hosting.

Another practice that is often used within Art of Hosting is to do a check-out as a way to close the circle, to converge and yo end the convening, and so this is our check-out:

Elina & Daniel on what’s next: We are not at the end, nor at the beginning of the end, and possibly not even at the end of the beginning. We are home, and still, we are also a long way from home. We are on a learning path where every step we take teaches us and makes us more humble. And with this telling, we invite all of you to learn together with us, to poke and question our, your own and everyone else’s seldom-questioned truths (“everyone knows that….”). But also join us in being grateful to be alive, and in feeling sorrow for all that will be lost, and in awe of all that will be born. For those of you who at this point are rolling your eyes, thinking we are late to the party - sorry, we couldn’t have done it faster, but we’re here now, so let the funeral wake and the party begin! For those of you who roll your eyes and wonder what the heck we are babbling about - no worries, we’ve been there too!

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