Care ethics to develop computing and engineering education for sustainability

Anne-Kathrin Peters
Department of Information Technology
Uppsala University
Uppsala, Sweden
anne.peters@it.uu.se

Stefan Bengtsson
SWEDESD
Uppsala University
Uppsala, Sweden
stefan.bengtsson@swedesd.uu.se

Åsa Cajander
Department of Information Technology
Uppsala University
Uppsala, Sweden
asa.cajander@it.uu.se

Mats Daniels
Department of Information Technology
Uppsala University
Uppsala, Sweden
mats.daniels@it.uu.se

Virginia Grande
Department of Information Technology
Uppsala University
Uppsala, Sweden
virginia.grande@it.uu.se

Johanna Lönngren
Department of Science and Mathematics Education
Umeå University
Umeå, Sweden
johanna.lonngren@umu.se

Minna Salminen-Karlsson
Centre for Gender Research
Uppsala University
Uppsala, Sweden
Minna.Salminen@gender.uu.se

***Abstract*—The aim of this special session is to connect researchers interested in computing and engineering education for sustainability. We will explore the use of care and care ethics as a theoretical perspective to develop sustainability education. Theoretical discussions in environmental and sustainability education (ESE) research and feminist research will be introduced to develop an understanding of care for education. Those theories will be illustrated and motivated based on concrete examples in computing and computing education. The participants get to choose among four different topics of discussion in the session, 1) the role of education to prepare for care, 2) theoretical discussions of care as a concept to develop education and education research, 3) pedagogical methods to foster care, 4) care and responsibility in the curriculum. The outcome of this session is two-fold: The participants will gain new ways of conceiving education for human and planetary well-being and they will get to know researchers and educational developers with an interest in and experiences with sustainability education.**

***Index Terms*—computing education, higher education, sustainability, care ethics**

I. Introduction

We are facing severe sustainability challenges. According to the intergovernmental panel on climate change (IPCC), we need rapid, unprecedented societal transformation in order to reach the global sustainability goals, e.g. to keep global warming below two degrees celsisus [1]. Information technology (IT) has proven to have particular potential to achieve such transformation as it changes patterns in consumption, communication, and our understanding of sustainability [2], [3]. IT is seen as important for the prosperity of our society and our society is getting increasingly digitalised. However, IT is also found to catalyse social, economic, and ecological challenges [2]. IT professionals are in a position to contribute to the well-being of humans, societies, and the planet, however higher education in IT does not seem to prepare them for this task.

Contrary to the common emphasis on the positive potential of education (see e.g. the United Nation's Sustainable Development Goal 4 [31]), computing education may actually lead to unsustainability rather than sustainability. A longitudinal study conducted at a Swedish university [4], [5] for instance shows how students are socialised to become narrow-minded technical problem solvers. As such, they are keen on, and competent in, developing technical artefacts without engaging in broader social, societal, or ecological questions. Computing education seems to lack an ambition to care for the well-being of humans and the planet. One explanation is that care historically has been relegated as the concern of women, working-class people, and ethnic minorities [6], demographics that are under-represented in computing. Another explanation is that the education focuses on cognitive development and little on emotional engagement with the world. This is problematised in research on education for sustainability [7]. However so far the role of computing education to address sustainability is hardly researched [8]. Engineering education research has come further with the topic of sustainability. There are some articles on care and feminist perspectives to study and develop engineering education, e.g. [24]–[26].

This special session aims to connect researchers and educators interested in engaging with care and empathetic aspects

of learning in order to develop computing and engineering education in a way that students thrive, not wither, in their capability and willingness to contribute to sustainability. The facilitators will motivate and illustrate care in the context of computing and computing education. The term computing is used as an umbrella term that spans different fields and traditions including computer science and computer engineering, as is reasoned about by Tedre [27]. As such, this session is in particular interesting to computing education researchers and educators, but should also be valuable for engineering education researchers from other fields interested in care and sustainability education research. The ambition of this special session is to bring together people with different experiences or interests in sustainability education, focusing the discussions around the concept of care and care ethics as a theoretical framework in order to develop sustainability education in engineering and computing education. How could we rethink computing and engineering education to promote caring for planetary and human well-being?

Care has been theorised in philosophy, political theory, and feminist studies, and those theories are being used to develop education for sustainable development (ESD) [9]. Contemporary understandings of the learner as an individualistic and rational subject are being critiqued in ESD [7], in a way that it has implications for the understandings of care for education. Care can no longer be understood as something that is initiated by the subject, but needs to be developed as a foundational disposition [10]. Here, education has an important role to play, sensitizing the learner to care. According to Heidegger [11], one already finds herself caring, being caught up in care. Education engaging with care does then not develop a primary rational capacity that allows for the emergence of care but could rather be understood as a means of (re-)sensitising the learner to a disposition always already there. Feminist research conceptualises care values in terms of attentiveness, responsibility, nurturance, compassion, meeting others' needs. Tronto as other researchers, argues that both men and women care, but that care has been defined as women's sphere [6]. She also gives reasons for why care ethics is necessary for creating a sustainable society.

What is the role of education to care for the well-being of humans, our society, and planet? This special session will provide an opportunity to initiate collaboration among researchers from different fields, as well as to explore new research questions and approaches that will make higher education in computing and engineering more relevant for our society and for addressing the pressing sustainability challenges that we are facing.

As the facilitators will primarily discuss care in computing education, we focus on reviewing sustainability education in computing education in this proposal. After that, we give a short overview of theories of care in ESD and feminist research. Then, we describe the organisation of the session and the backgrounds of the facilitators of the session.

II. Sustainability in Computing and Computing Education

A recent review [8] of sustainability education in computing education shows that there are hardly any research articles on sustainability education in computing education, while there is much more research on sustainability education in other adjacent research communities, e.g. in engineering education or science education research. The focus within the computing education community has primarily been on the acquisition of programming competence [12].

However, computing and sustainability is a growing research field [2] and some of the researchers in this field are also developing and publishing about education (cf. [13]). Pollock et al. [8] interviewed "experts" who research and teach about IT and sustainability. In these interviews, experts said that sustainability education is mostly recognised as important by students and teachers in computing today. However, teachers lack competence to teach about sustainability and still there are also opinions that computing education should support technical competence only.

Within the research field of computing and sustainability, practices in computing are being criticised as unsustainable, e.g. the short term focus when solving problems and the approach to problem solving applying a limited set of tools or methods such as data structures and algorithms [14]. If computing is to be relevant for sustainability, it should be addressing dilemmas in reaching a more sustainable way of life [14]. Another emphasis criticised by research is the focus on creating new and ever-faster technology [15].

Such criticised unsustainable computing practices can be seen as predominant in computing education. A longitudinal study that was conducted in Sweden [4], [5] has shown how the students are encouraged to adopt a narrow understanding of the discipline as purely technical. For example, a book called the "bible" is passed on from student generation to student generation as the only book a student needs to have, that only contains necessary text about all data structures and algorithms that the students need to read as IT professionals. In a recent article, Malazita and Resetar [16] argue that computing education produces "anti-political subjects" due to the focus on abstractions that serves as an "epistemic, cultural, and ideological wall" to integrating critical-technical education. Computing in the western world is also found to be co-produced with masculinity [17]. This implies dualistic constructions of computing as technical rather than social, as theoretical and not applied, and as a discipline in which mathematic reasoning is important and not engaging with human needs.

This is not to deny that there are initiatives to reform computing education as there is, for example, a framework for preparing students to contribute to the social good [18]. However, the way this framework is motivated, developed, and presented is problematic. It is argued in the articles presenting the framework that computing for the social good is important because students have wrong, stereotypical perceptions of the

discipline as "boring, tedious and irrelevant" [18, p. 16]. Computing can however really be constructed in narrow and stereotypical ways at university, which is something that needs to be changed. Here, we need to consider and address how computing is constructed in the interaction between different actors, e.g. students and teachers, and in curriculum as well as in teaching and assessment modes [28]. A question then is in what ways care as an orientation could help.

III. Theories of care in sustainability education and feminist research

Conceptions of care and the necessity of care to reach sustainability has been developed in environmental and sustainability education (ESE) research and feminist studies.

Within environmental and sustainability education (ESE) research individualist and rationalist accounts of the learner have been problematised [29]. Individualist accounts of learning are problematic as they for example lack the ability to account for social dimensions of learning [29]. Rationalist accounts of learning are problematic in the sense that learning is only reduced to reason and cognition excluding aesthetic and emotional dimensions of learning. Given the rationalist and individualist outlook of contemporary education, the learner is caught up in an inescapable loop of self-concern [19]. Care in general can be understood as an "activity that includes everything that we do to maintain, continue, and repair our 'world' so that we can live in it as well as possible" [30, p.40]. Care implies that we reach out to other than self, and care suggests action for well-being. The focus on care can thus help to foster the social dimension of learning. It has the potential to develop education in a way that all three dimensions are addressed, the cognitive, the emotional and the behavioural. A better balance in these three aspects in education is important to further sustainability according to a recent report by the United Nations [7].

Osberg [9] reviews different conceptions of care to develop an education that would allow us to take care of the future. She argues that conceptions of an education for care exist but that the awareness of such theories is still lacking.

Feminist research provides further insights about the absence of care in computing education. Noddings [20], [21] argues that care is neglected in the current society, including education, because of the assumed propensity of women to care. She asserts that care is not a feminine, but a human condition. According to her, care should not be intellectually taught, but the propensity to care should be enhanced in education. While Noddings still sees women as differently predisposed to caring than men, Tronto [22], [23], is very clear in arguing that both men and women care, but that care has been defined as women's sphere and as such consequently denied a position in the current societal discourse. She is also very clear about the necessity of care ethics for creating a sustainable society. Both arguments are relevant in relation to computing education and its place in society. As to how computing education could remedy the absence of care, Riley's [24] considerations, on feminist ethics in engineering education are highly relevant. Riley refers to criticisms of masculinist ethics, prevalent also in engineering, that stress the perception of human beings as independent and abstract agents, and the focus on rights, rather than needs. According to her, engineering education should use broad questions and examples including people's concerns in relation to the technical issues presented and help students to discuss both power and agency, and their limits, of the engineering profession and engineers

IV. Organisation of the Session

The special session will be organised approximately as follows:

15 min: The special session will introduce and motivate care ethics to develop education for sustainability. A couple of cases will be presented that stimulate discussions about education's role in preparing students for care and responsibility. Those cases could be the spreading of pornography and discrimination through information technology, changing work environments in health care because of IT, the extensive use of sparse resources or electricity in computing etc..

30 min: The participants get to choose a table in which the role of education for care and responsibility will be discussed with different focuses. Depending on their interest and experiences with the topic, as well as their personal motivation attending this session, they choose between:

- Discussion of the role of education to prepare for care, based on the cases presented and other examples
- Theoretical discussions of care as a concept to develop education and education research
- Pedagogical methods that foster caring identities, e.g. wicked problems, open-ended problems etc.
- Care and responsibility in the curriculum: Looking at the ACM/IEEE Curriculum, what is computing and engineering education's role in preparing students to care for and take responsibility for people's and the planet's well-being?

20 min: Each group summarises the group work for all participants, including questions that the groups found interesting to explore further in future work.

15 min: Discussion on how to move forward reviewing the questions that were presented by the different groups. Possibilities for joint publications or working groups (e.g. at the ITiCSE conference) will be discussed. We will collect email addresses of those interested in further collaboration. Furthermore, we will distribute a list of references about care ethics and sustainability education to the participants.

V. Facilitators

All facilitators are researching computing and engineering education and are working with sustainability in a broad sense in either their research or teaching. Anne-Kathrin Peters is a postdoctoral researcher researching identity, norms and values in computing and computing education. Åsa Cajander is a professor in human computer interaction who is also researching computing education, in particular professional

competencies, which is also a special interest of Mats Daniels, professor in computing education. Cajander, Daniels, and Peters have been involved in developing and researching the IT in society class, an open-ended group project course in which the students address complex questions for a real client. Virginia Grande is a PhD student who researches role models to address under-representation, but also to broaden the discipline and to bring in content that is being marginalised. Johanna Lönngren is a postdoctoral researcher studying approaches to integrate sustainability in engineering education. Minna Salminen-Karlsson is researching how gender produces and is produced in IT education and Stefan Bengtsson investigates environmental and sustainability education. Peters, Salminen-Karlsson, Bengtsson, and Cajander are collaborating in a research project on care in computing education.

REFERENCES

[1] Intergovernmental Panel on Climate Change (IPCC), "Global Warming of 1.5°C", 2018

[2] L.M. Hilty and B. Aebischer, "ICT for sustainability: An emerging research field", in L.M. Hilty and B. Aebischer (Eds.), "ICT Innovations for Sustainability", Springer, pp. 3-36, 2015

[3] R. Bendor, "Interactive Media for Sustainability", Palgrave Macmillan, 2018

[4] A.-K. Peters, "Learning Computing at University: Participation and Identity: A Longitudinal Study", PhD Thesis, Uppsala University, Sweden, 2017

[5] A.-K. Peters, "Student Experience of Participation in a Discipline – A Longitudinal Study of Computer Science and IT Engineering Students", ACM Transactions on Computing Education (TOCE), 19(1), 2018

[6] J. C. Tronto, "Creating Caring Institutions: Politics, Plurality, and Purpose", Journal Ethics and Social Welfare, 4(2), p. 158-171, 2010

[7] UNESCO, "Educational Content up Close: Examining the Learning Dimensions of Education for Sustainable Development and Global Citizenship Education", 2019

[8] I. Pollock, B. Alshaigy, A. Bradley, B. R. Krogstie, V. Kumar, L. Ott, A.-K. Peters, C. Riedesel, C. Wallace, "1.5 Degrees of Separation: Computer Science Education in the Age of the Anthropocene", in Proceedings of the 2019 ACM Conference on Innovation and Technology in Computer Science Education (ITiCSE), 2019

[9] D. Osberg, "Taking Care of the Future? The complex responsibility of education and politics", in: D. Osberg & G. Biesta (eds.), "Complexity Theory and the Politics of Education", Sense Publishers, 2010

[10] R. Lilly. "Fundamental Dispositions in Heidegger's Thought", Tijdschrift Voor Filosofie 50(4), p. 668-694, 1988

[18] M. Goldweber, J. Barr, T. Clear, E. Patitsas, S. Mann, and S. Portnoff, "A Framework for Enhancing the Social Good in Computing Education : A Values Approach", in Proceedings of the final reports on Innovation and technology in computer science education 2012 working groups, 2012

[11] M. Heidegger, "Sein und Zeit", 1967th ed., Max Niewmeyer Verlag: Tübingen, 1967

[12] Simon, "Emergence of computing education as a research discipline", PhD Thesis, Aalto University, Finland, 2015

[13] E. Eriksson and D. Pargman, "ICT4S Reaching Out: Making sustainability relevant in higher education", in Proc. 2014 conference ICT for Sustainability, Atlantis Press, 2014

[14] S. Easterbrook, "From computational thinking to systems thinking: A conceptual toolkit for sustainability computing", in ICT for Sustainability 2014, Atlantis Press, 2014

[15] J. Chen, "Computing within limits and ICTD". First Monday, 20(8), 2015

[16] J.W. Malazitaand and K. Resetar, "Infrastructures of abstraction: how computer science education produces anti-political subjects", Digital Creativity, 30(4), pp. 300-312, 2019

[17] W. Faulkner, "The technology question in feminism: A view from feminist technology studies", Women's Studies International Forum, 24(1), p. 79–95, 2001

[19] H. Lotz-sisitka, "Education and the Common Good", B. Jickling and S. Sterling (eds.), "Post-Sustainability and Environmental Education", Palgrave Macmillan, pp. 63–76, 2017

[20] N. Noddings, "Caring, a feminine approach to ethics and moral education", Berkeley: University of California Press, 1984

[21] N. Noddings, "Caring. A relational approach to ethics and moral education", Berkeley: University of California Press, 2013

[22] J. C. Tronto, "Moral Boundaries. A Political Argument for an Ethic of Care", Routledge, 1993

[23] J. C. Tronto, "Caring democracy: markets, equality, and justice", NY University Press, 2013

[24] D. Riley, "Hidden in plain view: Feminists doing engineering ethics, engineers doing feminist ethics", Science and Engineering Ethics, 19(1), pp. 189-206, 2011

[25] K. L. Gunckel and S. Tolbert, "The imperative to move toward a dimension of care in engineering education", Journal of Research in Science Teaching, Special Issue: A Critical Examination of the Next Generation Science Standards, 55(7), p. 938-961, 2018

[26] D.P. Michelfelder, S.A. Jones "From Caring About Sustainability to Developing Care-Ful Engineers", in W. Leal Filho, S. Nesbit (eds) New Developments in Engineering Education for Sustainable Development, World Sustainability Series, Springer, Cham, 2016

[27] M. Tedre, "The science of computing. Shaping a discipline", Taylor & Francis, 2015

[28] L. Ulriksen, "The implied student", Studies in Higher Education, 34(5), 517– 532. 2009

[29] A. Manni, K. Sporre, and C. Ottander, "Emotions and Values – a Case Study of Meaning-Making in ESE", Environmental Education Research, 23(4), Routledge, p. 451–464, 2017

[30] B. Fisher and C. Tronto, "Toward a Feminist Theory of Care in Abel", E. Abel and M. Nelson (eds.), "Circles of Care: Work and Identity in Women's Lives", New York Press, 1991

[31] United Nations, About the Sustainable Development Goals, https://www.un.org/sustainabledevelopment/sustainable-development-goals/