Sustainability in computing education: The value of differing educator perspectives

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Abstract. Computing professionals need to address sustainability-related challenges in their work, and computing education must help the students develop relevant sustainability competencies. The integration of sustainability in study programs is required by the higher education institutions. Meaningful integration depends on establishing the relevance of sustainability to the goals and tasks at hand. This paper shares findings from in-depth interviews with supervisors of master projects across different subfields of computing, focusing on how sustainability is addressed generally and how it is contextualized in subfields of computing and more widely. We use the theoretical lens of Communities of Practice to consider how a sustainability framework and vocabulary may serve as a boundary object between, on one hand, curriculum development and teaching, and, on the other, practice within the computing subfields. Drawing on this perspective we discuss implications for the integration of sustainability in computing.

Keywords: Sustainability competencies, Curriculum development, Sustainability education, Communities of practice.

1 Introduction

Digital solutions are integral to most aspects of modern society and have a significant impact on sustainability. Computing professionals thus play an important role in making solutions sustainable.

Across disciplines and professions, the set of competencies necessary to address sustainability have been identified as wide and holistic [1]. In the computing field, industry recognizes the need for sustainability competencies and skills. For instance, a recent study found that for software engineers there is a demand for 1) comprehensive and multi-dimensional understanding of sustainability and its alignment to business opportunities, 2) proficiency in soft and sustainability skills needed to promote awareness among stakeholders, and 3) tools and metrics to integrate sustainability in products and processes [2].

The importance of sustainability on a societal level is reflected in the strategies of higher education institutions, both for research and education, for which there is an expectation that sustainability aspects be integrated into the curricula. The need for computing to integrate sustainability into professional norms and practice, with education as a key enabler, is gradually being acknowledged and taken into account by the

professional communities e.g. ACM [3] and CDIO [4], albeit with varying vocabulary on sustainability aspects (e.g. professionalism, ethics).

In this paper, we consider sustainability in a wide sense, in line with the view reflected in the UN Sustainable Development Goals [5]. Sustainability, from this perspective, covers different dimensions, where impacts and concerns on various dimensions intertwine and often conflict. The three sustainability dimensions traditionally included, e.g. by the Brundtland commission [6], are the societal, economic, and environmental one. Other frameworks differentiate further to include e.g. an individual and a technological dimension of sustainability.

The way educators make sense of sustainability in considering and developing their teaching is reflected in discourse among colleagues and has an impact on the alignment of their work with university strategy [7]. In discussions among educators involved in collaboration, e.g. on a study program, there are typically some voices that are louder than others. While important and valid, the most strongly stated opinions do not provide the full picture of how the scientific staff generally see the issues in question.

The objective of the work presented in this paper is to investigate and elaborate on the understanding of sustainability among educators in computing. Our underlying agenda is to promote shared understanding and effective collaboration on the integration of sustainability in computing education. Empirical data for the study have been collected from a Computer Science department in a Norwegian university. Through in-depth interviews with seven scientific staff members representing various subfields of computing, we provide a picture of the breadth of perspectives on sustainability as part of the computing field. We next proceed to discuss what might be the implications for the development of computing curricula. The following research questions guide the study:

RQ1: How is the concept of sustainability understood by thesis-supervising educators in computing education?

RQ2: In what way are perspectives on sustainability contextualized by the same educators?

RQ3: What may be positive and negative impacts on curriculum development of the current perspectives on sustainability?

The paper is structured as follows: Section 2 provides background on sustainability competencies and the Communities of Practice (CoP) perspective on curriculum development. Section 3 presents our empirical case, and Section 4 outlines the research method. Findings are described in Section 5 and discussed in Section 6, which also concludes the paper.

2 Background: Sustainability competencies and a Community of Practice perspective on curriculum development

Given the magnitude and complexity of current and future sustainability challenges faced by society and the computing profession, computing professionals need a broad set of competencies to be able to properly address sustainability in their work. *Sustainability competencies* are disciplinary as well as transdisciplinary and have a significant

overlap with professional competencies long recognized in computing education [8], including transversal/non-technical skills in areas such as teamwork, critical reflection, systems thinking and future thinking. There are also what can be considered as fundamentals of sustainability: key issues and principles, including relevant concepts (such as circular economy) and frameworks (such as the UN sustainable development goals [5]), which can be seen as a vocabulary for students and educators to teach and learn in this area. A further dimension recognized as important is the set of competencies needed to support students in handling the emotional aspects of work with sustainability challenges [9].

Several frameworks are available to help facilitate the recognition and operationalization of sustainability competencies in higher education, e.g. [1]. Such frameworks have proven useful to support evaluation [10] and the design of learning activities (see e.g.[11]). In line with constructive alignment [12], learning objectives, described in terms of competencies [13], should be achieved through learning activities leading to these competencies and evaluated through adequate forms of assessment.

For computing education to provide sustainability competencies with reasonable certainty, sustainability needs to be part of the curricula. The integration can be more or less profound [14], changes ranging from smaller modifications of existing courses and modules, via dedicated sustainability courses and more extensive course revisions, to wholly new study programs. In a review of current approaches to integrating sustainability in computing education, [15] identify a potential for improvement. They propose that computing education focus e.g. on making curricular changes that engage with the seriousness of the issues at hand, that we move from curricular alignment towards exploring new skills and attitudes, and that we work on the understanding of power relations, equality and justice.

Actively steering towards learning objectives formulated as sustainability competencies is helpful in such curriculum development, e.g. to ensure that the study program learning outcomes are reflected in the appropriate coverage and progression of the relevant competencies across the constituent courses.

Curriculum development is, however, influenced by various practices, guidelines, constraints, and bodies of knowledge applied in, or otherwise having an impact on, the teaching. Educators have differing competence on sustainability in general, and differing awareness of its relevance for their field. They also have varying enthusiasm for imposed requirements to update their curricula to include sustainability topics.

A theoretical perspective adequate for shedding light on the complexity and dynamics involved in curriculum development is Communities of Practice (CoP) [16]. A CoP is characterized as a unit of people with mutual engagement, a joint enterprise, and a shared repertoire. The concepts of *boundary objects* and *brokering* are useful for shedding light on changes taking place when individuals have roles in more than one community. Boundary objects originate in the work of Star and Griesemer [17]. A boundary object is something which has an identity and a meaning in two or more different communities, contributing to the meaning-making in each community. Furthermore, a boundary object is "both plastic enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites" (p.393). In Wenger's conception of CoPs, boundary objects play a central

role in the development and mutual influence of intersecting communities. Another key role is played by community members who are members of both communities and take the role as *brokers* "able to make new connections across communities of practice, enable coordination and – if they are good brokers – open new possibilities for meaning" [16] (p.109).

There is a body of research on curriculum development and organizational change in higher education drawing on the CoP framework, e.g. [18, 19]. For instance, in the context of business schools [20] argue that embedding sustainability depends on the development of suitable boundary objects supporting participatory curriculum development.

In our study we are particularly interested in two types of intersecting communities: What we will call the *department-level collegial community (DeptCoP),* its members together responsible for offering study programs in line with decisions and policies, and the communities defined by the *disciplinary subfield of computing (DiscCoP)*. A member of scientific staff (from here onwards denoted *the educator*), is a member of DeptCoP as well as at least one DiscCoP, the latter typically reflected in their research activities, the types of courses they teach, and the types of student projects they supervise. In developing their teaching and supervision practice, an educator has to relate to the norms and practices both of DeptCoP and DiscCoP.

As the focus of our study is the integration of sustainability into computing education, including master theses, we are interested in the intersection of DeptCoP and DiscCoP. Choosing to consider these two types of community, we acknowledge that the set of relevant CoPs to which the case may be related, is larger and more complex. We will refer to other communities or contexts when we believe them to be of particular importance to the interpretation of our findings.

3 Case

The case explored in this study is a Computer Science department (DEPT) in a Norwegian university (UNI). DEPT provides several bachelor and master level study programs. The programs, including specializations within the programs, cover a broad range of fields, from computer hardware to business and organization.

Sustainability is part of the UNI strategy. Among two recent university wide projects to develop the principles of the study programs of the future, SUST-TECH <reference omitted for anonymity> covered the science and technology programs. SUST-TECH resulted in a set of principles and guidelines that have partially been applied in the development of study programs, and that will be further applied in the years to come. The program advocates a holistic approach to teaching and education and promotes an integration of sustainability in courses and study programs.

On this background, DEPT is, "from above", required to incorporate sustainability in their study programs. Bottom-up, many among the scientific staff conduct research on sustainability-related challenges and have integrated sustainability in their teaching.

One action that has been taken in DEPT is to modify the course descriptions of bachelor and master project courses by specifying (using various wording) that the theses

reflect on the project in relation to the UN SDGs. While a couple of study programs have come further in formulating more detailed sustainability-learning outcomes, by 2024 it was generally recognized that the requirement to integrate sustainability in bachelor and master projects was too vague, resulting e.g. in supervisors giving different advice on the matter. As part of the effort to address this, DEPT developed a sustainability web resource for students and supervisors. The resource was made available late in the spring 2024 and was later revised based on feedback from students and staff.

The website presents some motivation for addressing sustainability in a thesis. It also gives an introduction, with examples, of how to apply a specific sustainability analysis framework to a bachelor or master project. The framework, SusAF, originates in Software Engineering and supports analysis of sustainability effects of a digital solution on various dimensions (environmental, social, economic, individual, technical) and with different time frames [21]. The analysis includes identification of chains of effects, illuminating conflicting concerns and dilemmas. In DEPT, there was already positive experience with use of SusAF by students in some courses, which led to the choice of the framework as a resource for all bachelor and master projects.

As of spring 2025, informal feedback and discussion indicated highly varying use of the resource in the master projects. Concerns and viewpoints seemed to reflect differences among types of projects and among subfields of computing. This triggered our interest as computing education researchers and contributors to further development of the web resource. To learn more, we decided to conduct a set of interviews with supervisors of master projects at DEPT.

4 Research method

The interviews took place in the period Sept. 2025 – Jan. 2026. The respondents were master thesis supervisors, in the age group 45-65, employed in DEPT as full or associate professors, and including both genders. The study was approved by SIKT.

The general purpose of the interviews was twofold: 1) Explore views of the sustainability resource among supervisors 2) Explore views of, and approaches to, sustainability, especially as part of master and bachelor projects. For the study presented in this paper, focus is on respondents' views of sustainability in general and as contextualized in their field, e.g. in the master projects they supervise.

Respondents were recruited through purposeful sampling, with the aim of a broad coverage of research/teaching areas as well as balance among genders. All invitees were assumed to be sufficiently interested in sustainability in computing education to want to engage in in-depth conversation, but not necessarily enthusiastic about sustainability as such or specific approaches to sustainability in courses/study programs. Only one educator did not respond to our invitation; all others agreed to participate.

Two of the interviews took place in-person, the rest (deliberately) digitally to facilitate better quality of the automated (draft) transcription. Six of the interviews lasted 45 mins; one 1.5 hr. The interviews were semi-structured and characterized by an informal tone. The researcher knew the respondents as colleagues, with varying degrees of familiarity. Three interviews were in English, four in Norwegian.

Table 1. Respondents with their general fields of research and master thesis supervision

Respondent	Gender	Main computing subfield / research area
R1	F	Information systems
R2	F	Collaboration technology / Learning technology
R3	M	Algorithms
R4	F	Software engineering
R5	M	Project management / Software development
R6	M	Software engineering
R7	M	Computer architecture / Hardware

The interview transcripts were checked against the audio recording and edited for clarity. For this paper a full edit was done for relevant sections of the interviews answering the questions "How do you understand the concept of sustainability, assuming a broad understanding?", "For the theses last spring, what advice did you as a supervisor provide regarding how sustainability be addressed in the theses?", "What form of support for working with sustainability in bachelor- and master theses would be good and useful?", and "What are your thoughts about the requirement to integrate sustainability in bachelor- and master theses being the same for all types of theses?"

Thematic analysis was conducted in NVivo, with inductive coding performed by a single reviewer, who had also been the interviewer. Initial codes were informed by the interviewer's impression from the data collection, especially how the understanding of sustainability often was connected to the respondents' computing subfield. Further identification of codes in iterations on the data refined this picture. Two main themes were identified: Sustainability as general topic, and sustainability as contextualized.

Findings were extracted from the interviews based on the relevant codes and analyzed within the selected theoretical framing, i.e. CoP with boundary objects and brokering. Translation of Norwegian interview data into English as well as edits for brevity and legibility were done by the author on the extracts to be presented in the paper.

Regarding limitations to this approach, we would like to mention two aspects of the interviews warranting some caution in our interpretation of the findings.

First, through the question formulation we deliberately encouraged the respondents to address sustainability from a broad perspective, in line with the UN SDGs and SusAF, and thus the "official" take on sustainability at DEPT. We did not investigate whether the interviewee would, un-prompted, take a narrower view. There were however no signs of narrow perspectives on sustainability in the interviews.

Second, the respondents had to varying degrees been exposed to the sustainability web resource, and some of the respondents had applied SusAF in context of master supervision or other courses. The differing knowledge about SusAF might have influenced how sustainability was addressed, e.g. in terms of vocabulary. At the same time, SusAF, by referring to dimensions of sustainability, builds on well-known perspectives on sustainability found e.g. in the Brundtland report, which can be regarded a shared vocabulary in DEPT.

The interviews provided ample opportunity for the respondents to elaborate on perspectives on sustainability, based on their senior-level experience in research, teaching and supervision. We believe that prior exposure to SusAF and the prompting for a broad perspective did not significantly limit the respondents' reflection on sustainability.

5 Findings

The findings section is organized according to the two main themes: First, we address the respondents' understanding of sustainability as a general topic. Second, we turn to perspectives on sustainability as contextualized, linked to key aspects of a project within a certain subfield of IT. The excerpts from the data provide a picture of the breadth of sustainability concerns addressed across various types of projects. In presenting these data, we have chosen to prioritize excerpts, assuming that the way the respondents address sustainability in their answers is in itself interesting in light of our research questions. In the text, angle brackets have been used in the following way: to indicate that a less important part has been omitted (shown as "<..>"); to explain what was said/referred to; to explain what happened at that point, e.g. laughter

5.1 General understanding of sustainability

The data related to this theme mostly originate in the question on how the respondent sees "sustainability", given a broad understanding of the concept.

Regarding frameworks and vocabulary, two respondents refer to the Brundtland commission. R1 says: "<sustainability> can be many things, but I usually go with that definition from the Brundtland commission <..which is about doing things..> without compromising the ability of future generations to meet their own needs. <..> As little harm as possible. But I also think that everything is related. <..> It becomes completely impossible to avoid some harm somewhere. But it is about finding a <..> best tradeoff rather than an optimal solution. So I am thinking rather widely, not in one silo. To me it is very important and easy to think in that way."

Through her phrasing "go with", R1 also seems to refer to her application of her understanding of sustainability in the teaching/supervision situation.

R5 also starts out with the Brundtland report but continues to ground his view of sustainability in everyday life and aspects of modern society: "I think I went to high school when the Brundtland commission launched their report. <I understand sustainability> as acting so that you can continue doing the same thing in the future without resources being destroyed or degraded. Society was a lot more sustainable in the old days, as people re-used resources and utilized them to a much larger extent. Today there is more throwaway culture which is not really very sustainable. <..> I believe sustainability is strongly connected to the quality of products, so that we ought to have stronger requirements for quality <continuing to talk about repairs at home with an example from his own family>".

R3 connects sustainability to questions of justice and making the world better, and also to individual self-care and life-work balance: "So the basic idea is that if in a sense

you follow one path, you will in the end begin to fail, because that is in a way the essence <..> Things break if you do it this way, if it is not sustainable over time. <..> I talk to master students about exploiting (Norwegian: drive rovdrift på) yourself during the master. Kind of think you will get a lot done, but then it is not sustainable, so that you crash and get to do less in total." He continues to elaborate on how an approach which might appear to be less goal-directed, can be more sustainable in the long run. "<..> slow down a bit and take care of yourself or the environment or society or whatever; maybe the chance is bigger that you achieve what you want". "To me, this is what I have perceived about the sustainability thing, actually trying to make the world better. And in a more just way, too. "

R2 points out how a broad perspective of sustainability can be a problem, referring specifically to supervision and students' work. Implicitly she also refers to the dimensions e.g. found in the SusAF model: "I think one of the problems with sustainability is that when we're doing everything inside <..>, it loses focus. <..>. It's very difficult for <the students> to relate to something that goes in so many directions. For some, the environmental aspect may be more interesting, versus <for others> the social impact. The economic I haven't had anyone focusing on <laughing a bit>" She continues to explain about different master projects where students have focused on, and accordingly been the most interested in, specific dimensions of sustainability. In sum, R2 conveys that a (too) broad understanding of sustainability negatively affects students' motivation and ability to address sustainability in the areas most relevant to their project.

R4, on the other hand, stresses the importance of addressing *all* dimensions: "I think in general, student focus or when we talk about sustainability to computer science or in relation to computer science, there is a general tendency to go to the technical dimension of sustainability and not consider the other dimensions. And that's why it's important to clarify all 5 dimensions. And that's what we do in the advanced topic course, starting with all the five dimensions and see how computer science impact. Not only the technical, we should not only consider the technical dimension, but the other dimensions as well, and also differentiate these 2 aspects: sustainability in IT and sustainability by IT."

R2 and R4 may first seem to have opposite views on the importance of students applying a broad perspective. This is however not necessarily the case, as R4 points to the introduction of the framework in a course, whereas R2 focuses on the use of the framework in a master project, where the project is addressing a problem that might be more clearly linked to one or a limited set or sustainability dimensions. To understand the response of R4 it should be noted that she has prior research experience on sustainability in computing education, having published a paper on this topic a few years earlier, which means she is very familiar with relevant models and vocabulary, such as the terms "sustainability in IT" and "sustainability by IT".

Elaborating his understanding of sustainability, R6 refers to the work underlying the SusAF framework and a scientific paper on the framework that he has applied in his teaching: "<..> used in the intro course in software development. Because then we have used an article about sustainability that is relevant in our field. And I am thinking about the UN sustainability goals. And an elaboration of it, with some dimensions. That

maybe comes in <scientific work underlying SusAF> considering both technical, economical, individual, social and environmental consequences of systems being made" R6 thus refers both to established frameworks (UN SDGs, SusAF) and to the particular field of computing as a source of authority on what sustainability is.

Finally, R7 provides an explanation of sustainability referring to a basic principle: "I guess <sustainability> is to be understood as <..> our collective ability to run society in such a way that we do not increasingly use more and non-renewable resources".

In total, we note that some of the respondents related their explanation of sustainability to the teaching situation whereas others connect to spheres such as the individual's life, family, and society. Some refer to the frameworks involved in the material and approach to sustainability in education at DEPT, often based on prior experience in applying the frameworks. The respondents choose different entry points and perspectives, which served our intention of hearing respondents' "take" on the subject. None among the respondents (in cited answers or elsewhere in the interviews) signalled any negative attitude or lack of awareness of sustainability as an idea and societal challenge.

5.2 Contextualization of sustainability

The data for this theme originate in answers to various questions and follow-up questions in the interview.

Respondents whose scientific field includes SE tend to link the integration of sustainability to project phases and SE practices. The SusAF framework has a close connection to SE in this regard, originating in SE and Requirements engineering. The identification of sustainability effects as a means for defining requirements, in particular non-functional requirements, is a key point. R1 says: "One should think about it already in the design phase. So.. one talks about functional requirements, performance requirements, right. Interface requirements and so on. One should consider what.. is there anything that is privacy, sustainability.." Challenged by the interviewer to consider (master) projects that are not focused on the development of technology, e.g. projects asking to evaluate the implementation of a digital solution in an organization, R1 sees the framework as still relevant: "<Also then> it is very important with things like ethics and inclusion and.. multiple things like that." R1 sees sustainability as something that needs to be addressed throughout a project: "To get it into the students' thoughts in a natural way, it has to be something they are conscious about throughout the process"

R4 grounds her perspective on sustainability in Requirements Engineering and Software Engineering as well as in application of the SusAF framework, making a similar point as R1 about addressing sustainability throughout the project: "It should start from the beginning. They should <briefly address it in the> introduction and they should consider it as non-functional requirement from the beginning. <..> it should be like a common thread and they should test it just like they test other non-functional requirement. Because I think from students' perspective <..> because they are developing something in an applied computer science project, they need to develop something. <..> <The students> don't see the value <of reflecting on sustainability> until and unless they consider it <..> as a non-functional requirement." R4 proceeds to make a point

about what the students perceive as a valuable and meaningful way of addressing sustainability: focusing on the most relevant sustainability dimensions in the specific project "<..>when we are talking about different dimensions <..> depending on the topic they have, <..> when they are talking about technical dimension, they can talk about if it works for them in terms of performance <..> Or if they are doing something which impacts the user or participants, then there are other non-functional requirements which should be something related to <..> learning the system or using the system which comes under the social or individual dimension. <.. It> will depend on the thesis topic".

Being a SE researcher, R6 links sustainability to his field: "I know that in systems development, the field of software development in general, many have been interested in sustainability. In my subfield, Process, maybe there has not been that much, but where there has been the most work is on requirements <..> and architecture <..>. And <with architecture> there is systems performance and energy use and.. yes, the big design decisions and their environmental consequences. While around requirements work, it is broader, for instance thinking about how a system affects people, the total load of IT on people and… <..> many levels of consequences from making a new system." Regarding Process as a particular field of SE, R6 comments that it is harder to link to sustainability, the topics tending to be more remote from the product. He sees sustainability as more relevant when considering the product than the process. Thinking about it, he however adds: "Then again, there are things around the organization of work <around process..> outsourcing work to low-cost countries, then you touch upon sustainability goals. <..G>lobal software development is a separate subfield <and> there it is a topic.". To R6, professional practice and research within subfields of SE seems to be the main reference point when considering the relevance of sustainability.

R2 also refers to the profession, linking sustainability to responsibility and professionalism. She explains about a student master project on "dark patterns" in interaction design, where the student is creating a game. "So <..> all the patterns that help, that push you to say yes, <..> 'I share the data because <the alternative> is so much fuss'. <..> And <the student> is looking for patterns that explicitly are <intended to> stealing your attention. She wants to promote awareness about this pattern in students. <..> To understand <and> create empathy with the user. To say, OK, you may use this pattern, it is very useful to use. But what happens in the next step? <..> So, so in in a way we don't call it sustainability. We don't use the label sustainability, but you could as well use it. In a way all these pieces are about responsible <..> profession, <..> helping the student to understand the responsible implication of what they are doing."

R3, whose computing subfield is algorithms, takes particular interest in *computational social choice*, linking sustainability to social justice. He explains about the idea of Pareto dominance: "<..>if things get better for some and not worse for others, then it is <altogether> better. That is a kind of axiom that I see as fine. <..> It is once you start with tradeoffs that it becomes better for some and worse for others. Then it is more difficult to say what is right. But I think the only thing that fits in there is a certain degree of justice, that those who have it really bad can get it better, even if those who are better off get it slightly worse. <..> With such a basic view, most of the umpteen sustainability goals fit in, trying to avoid that the present and future become worse or

just as bad for those who have it bad. And try to make things better long term, kind of.“ Pareto efficiency, referred to by R3 in this excerpt, is a concept within optimization.

R5 in his initial considerations about sustainability referred to everyday product quality, repairs and reducing waste. As the interviewer responds by asking if by “products” he also meant IT solutions, R5 says “No, I am mostly thinking about physical products when I say that. <..> Software products are in a completely different category. But if we start talking about sustainability here, then it is of course important. There I think maybe it is more about robustness, about maintainability, extensibility and such things. That products are built <so that> they are easy to maintain and develop further. Because living with a <continuously maintained> software product is something completely different from living with some single product. <When> a consultant gets the task of making a system for a business <..> it is possible to make shortcuts and conclude that ‘the system is now running’. But a software developer who makes a living from software products in a ten year perspective..” R5 proceeds to elaborate by referring to his background from software industry. “<..>becomes a totally different exercise in terms of thinking about robustness, and then you should invest a fair amount of resources on designing reusable components <.. which is> a lot more sustainable than just designing single solutions.” R5 gives an example from his work in industry where functionality in a system was systematically addressed “<..> in the long run it pays off. <..> I think is an example of how to have sustainability in software development.”.

Later in the interview, R5 connects sustainability and project management, referring to short and long term project objectives and tradeoffs: “When you run a project, you do have goals of profit. <..> You can connect sustainability to the benefit. You wish to achieve something sustainable <..> have some savings in terms of increased efficiency or reduced amount of work; there are many such gains. <..> And this is to be established early in the planning of a project. In Prince 2 <..> the benefits you want to achieve are defined in business cases <..> at the start of the project.” R5 then elaborates on the creation of benefits realization plans and points out that benefits mostly come after the project has ended, i.e. when an implemented system makes work tasks more effective in an organization. “The sustainability contributes to economic sustainability <..> The way you work becomes better for the employees, so you have both individual and social sustainability, and so on.” With this framing, R5 thus links key sustainability aspects to project management and its considerations for the long- and short-term perspective, effects on various (sustainability) dimensions and chains of such effects.

The interview with R5 shows how the subfield-specific, including one’s own experience from professional work in the field, can serve as an entry point to reflection on, and elaboration of, sustainability aspects of practice.

R7 addresses sustainability with reference to his computing subfield, hardware: “<..>everyone agrees that sustainability is important <..> There are definitely sustainability consequences of all the <master> theses.” Here, R7 refers to master theses in his particular area. “<.. It> is a double edged sword. If for instance you want to do a so called Edge AI <..> the advantage is that you can get away with fewer data centers. And that may have a sustainability gain. The disadvantage is that you can get a <..> bunch of gadgets that you would not otherwise get, and that has a sustainability cost.”

R7 thus points to a major and timely sustainability issue related to AI, illustrating how sustainability typically entails difficult tradeoffs and dilemmas.

6 Discussion and concluding remarks

Revisiting RQ1, we ask: How is the concept of sustainability understood among the educators? Our findings indicate that the understanding is quite good, educators referring to key principles and frameworks and acknowledging the importance of sustainability as a societal challenge. From the CoP perspective, the accounts of sustainability indicate that there is a common language within the DeptCoP suitable for supporting engagement and discussion related to the development of study programs.

Turning to RQ2 and the question of how sustainability is being contextualized, the picture shows substantial variety even in our limited number of interviews. Common to the educators is the linking to their specific field of computing. In our findings this includes e.g. reference to aspects of project management, hardware and SE. Additionally, we note contextualization in society and in individual needs.
Contextualization is also done with reference to the teaching context, as in the issue of student motivation depending on addressing relevant sustainability dimensions. Such considerations might be regarded as practice within the DeptCoP. Finally, we note that the link between sustainability as conveyed in DeptCoP practice/guidelines and the way it is considered in the DiscCoP is not always immediately evident to an educator. Where the DeptCoP sustainability framework and vocabulary do not provide a direct connection, we note that reflection and personal experience can help in creating a link, e.g. from private consumption and resource use, to sustainability as project management.

Regarding RQ3 and the possible positive and negative impacts on curriculum development of the varying perspectives on sustainability, we have to be tentative. We see a potential in the observed contextualization of sustainability as a source of improved and shared understanding of sustainability. In the DeptCoP this could contribute to the desired holistic take on sustainability, difficult to achieve by way of a shared vocabulary and generic framework alone. Accounts by representatives of different subfields could be extended into cases for use in teaching and for building shared understanding among colleagues collaborating on the development of study programs. The educators responsible for the contextualization are thus brokers between CoPs, making connections across communities, enabling coordination and opening new possibilities for meaning. The broker role could be actively encouraged, e.g. in presentations and workshops.

SusAF and/or surrounding vocabulary, along with instantiations of the models with projects and problems belonging to the various DiscCoPs, may take on the role of boundary objects between DeptCoP and the DiscCoPs. We thus assume that these boundary objects have meaning and significance in each community while simultaneously acknowledging that they do not have to mean *the same* in the communities connected. Our study shows a potential for SusAF to inform the practice and knowledge development within the DiscCoP, e.g. by showing the relevance of the model to shed light on important aspects of a problem. Also, SusAF can facilitate interaction among

stakeholders within the DiscCoP, e.g. students or developers already familiar with SusAF. Finally, SusAF and/or related vocabulary and models may ensure rigor in linking practice in the DiscCoPs to concrete artifacts (e.g. manifest in templates or guidelines for students or examiners) acknowledged and kept up to date within the DeptCoP and supporting constructive alignment within the study program. In DeptCoP, instantiations of the framework may increase its usefulness to educators by making it more accessible.

Fig. 1 depicts a situation where a sustainability framework (e.g. SusAF) and vocabulary, with instantiations, serve as boundary objects between DeptCoP and Disc CoPs.

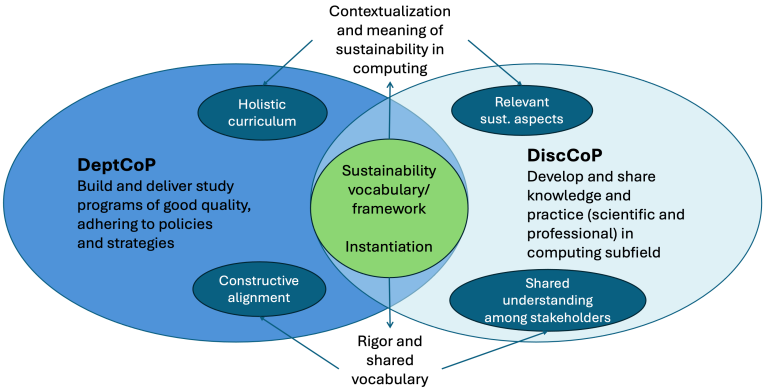


Fig. 1: The potential role of a sustainability framework as a boundary object

While our findings are primarily relevant to the setting in which the study took place, the challenges of including sustainability in curricula developed across multiple subfields of computing are more general. Revisiting the suggestions for improving the integration of sustainability in computing education identified in [15], we suggest that a richness in contextualization of sustainability can help computing education engage with the seriousness of sustainability issues and a better understanding of challenges e.g. related to power relations, equality and justice. For the community of educators to benefit, whether in a department or in the wider research community, useful contextualization needs to be shared. In addition to discussions within the CoP, we suggest that cases illustrating sustainability in computing from various perspectives be shared, utilizing the structure of the boundary object as a shared language. The teaching practice should actively make use of the resource, e.g. to develop computing curricula.

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