Role Modeling as a Computing Educator in Higher Education: a Focus on Care, Emotions and Professional Competencies

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ABSTRACT

This paper provides insights into role modeling by educators in computing that is beyond the technical, theoretical and rational perspectives which have historically been described as dominant in computing. Surveying 199 educators in higher education, we have built on frameworks of role modeling, care, emotions, and professional competencies as a lens to see different ways of engaging in computing.

Our quantitative and qualitative findings show how educators model ways of caring (for oneself, other humans and living species, technology, and the planet), emotions, professional competencies and other types of role modeling. Examples of contexts within computing and reasons why an educator can(not) model these aspects bring new light to research on care and emotions being shown in computing.

This work contributes to a better understanding of computing educators as potential role models, particularly in terms of displaying emotions and various types of care. Our work can support ways of developing the professional competences of computing educators and the teaching culture of computing departments. Our findings may inspire other educators to think about their own display of emotions and care, and what this transmits to their students.

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Thus, the work also contributes to the discussion of ways to increase diversity among students and equitable access to computing education.

CCS CONCEPTS

• **Social and professional topics** → **Computing education**.

KEYWORDS

teacher, educator, role model, professional competencies, emotions, care, higher education, sustainability

1 INTRODUCTION

Computing culture is repeatedly found to emphasize the technical, rational and theoretical concepts over social and applied engagement [32, 44, 47, 48, 62]. These cultural characteristics not only disadvantage the success of students from marginalized identities already in computing, who have been documented to be more drawn by socially impactful endeavors, but deter their interest and participation in the field altogether [31, 44, 63]. To strengthen the field we need to examine its practices and particularly those that make space for non-technical aspects of learning. In recent years, research in emotions and care has demonstrated that they can and should be a critical part of engineering and computing education

[8, 27, 36, 49, 60]. With the vision of contributing towards a larger goal of humanizing the computing field [81], we are engaging in a first exploration of computing educators' views on showing care and emotions to their students. We have done so through a theoretical lens of educators as role models.

Educators are potential role models as they interact with their students in many ways: giving a lecture, answering questions during office hours or during a lab session, replying to inquiries in learning management systems or by email, giving advice as supervisors, etc. In these various settings in and out of the classroom, through their example, computing educators can show achievements (e.g., a research paper being published), or aspects of themselves that students may observe and emulate. In particular, an educator can display a set of professional competencies needed to succeed in the discipline; a range of emotions that naturally arise as a reaction to events in the classroom (e.g., frustration when the technology does not work, enjoyment of one's job, distress or discomfort when teaching about climate change or exploitation and computing); different ways of caring about oneself or others (e.g., well-being practices, inclusive teamwork approaches, reflections on sustainability); and other values and behaviors. While educators always potentially are role models and may use their position to make certain aspects visible to their students, more research is needed on the educators' perspective of this phenomenon.

Previously, role modeling has mostly been studied in computing and engineering education in terms of the effects that having a role model can have on students, e.g. improving the student's motivation (for a review, see [14]), academic achievement [84], and self-esteem [82]); role models as one of the factors affecting students' aspirations in computing [80] and likelihood of participating in computing education [22]. Special attention has been given to identifying the role of gender, race and ethnicity, and other characteristics that the role model may or may not share with the student. There are many examples of initiatives with role models from and/or for members of groups that have been historically marginalized, e.g., [2, 25, 69, 79]. Frameworks and tools for effective organization of these initiatives are available, e.g., with a focus on gender [74].

Rather than looking at effects on students, here we studied what computing educators themselves perceive that they model or represent for their students in their teaching. It is especially interesting to study the perspective of educators, since it provides us with an understanding of what educators are able and willing (or not) to model in their everyday work. Inspired by the literature on underrepresentation and sustainability, as well as educators' professional competencies, we focused on educators' perception of how they show care and emotions. Through a multinational survey, we invited educators to reflect on what kinds of care, emotions, and other parts of themselves they thought they showed to their students, in which situation they did so (or not) and why. Our motivation for this focus is based on the following interconnected reasons:

(1) To contribute to the humanization of computing and engineering education and educators,
(2) To provide more research on emotions and care in computing and engineering education and educators,

(3) To understand how role modeling by educators, can have an effect on students' development and, in turn, affect society and the planet.

Care and emotions are seen as deeply human aspects that should be part of education and higher education institutions [38, 39]. Yet, previous research suggests care and emotions are lacking in computing education (Section 2). We are living in troublesome times and many young people are concerned about the state of the world and their place in it [41]. We believe that care and emotions are shown at least in some classrooms and by some individuals, maybe increasingly so. With this work we sought to understand examples of showing care as a step towards promoting care.

We studied educators' role modeling in the context of it potentially bringing in the classroom a range of human and professional aspects and representing different professional and disciplinary identities. When students are exposed to these potential role models, it provides them with a diverse set of ways to participate in computing. We also argue for role modeling to be seen as a complex phenomenon, as not all ways of being are perceived as legitimate in different social contexts [17]. Specifically, as computing is constructed as technical, aspects of role modeling that match this view of computing (and what it means to be a computer scientist) have more visibility than the aspects that go against this norm.

If we think about what we as educators can represent as potential role models, subject content knowledge and skills easily come to mind, e.g., in Grande et al.'s interview study, a computing educator hopes that students perceive him as someone *"who both knows how to code and to understand the deeper issues behind the design of programming languages and the theory of computing"* [16]. The value that learning about skills and knowledge related to computing has is obvious to both educators and students. An example of this is that ACM and IEEE computing curricula specifications were heavily oriented towards knowledge and skills (e.g., CS2013, SE2014, CE2016, CSEC2017 published on the ACM Curricula Recommendations page [1]). This has been noted as a problem, especially due to the huge impact computing has on our society, in which a more holistic perspective is essential. Recent ACM and IEEE curricular guidelines (IT2017 [61], IS2020 [24], CC2020 [5], CCDS2021 [6]) use the competence concept in efforts to the value of broadening computing education. Models of competence normally have a disposition (or attitude) component added to knowledge and skill components. One important aspect of such models is that it highlights the importance of addressing disposition when developing competence.

We posit that "humanizing" computing education by also addressing development of dispositions can be motivated through professional competence frameworks. We argue that the display of emotions and care enables and is enabled by dispositions, and thus should be part of professional competence. Today the emotions and care aspects are far less represented or seen as valid. Professional competence frameworks can support educators to actively (or less so) reflect on and be aware of what kinds of role modeling can be shown and under what circumstances, and factors that support or hinder showing aspects of themselves that the students can potentially emulate.

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[1]https://www.acm.org/education/curricula-recommendations

Furthermore, care ethics, seen as a relationship in which one is identifying, addressing and meeting the needs of oneself or others, relies on competencies. Handling emotions in a computing education setting is another set of self-regulation competencies that students need to develop. Such competencies have their limitations as not all ways of caring and being emotional might be expressed in terms of competencies, or as something that is to be acquired by all students (for example, distress about environmental degradation; also, not all students need to learn the same skills about care for oneself). The limits to defining competencies are discussed in recent education work (see e.g. [20]). In this paper, we apply a rather open approach to exploring how educators show or do not show care and emotions, and how competencies may relate to care and emotions.

Another way to approach competencies is to look at the competencies educators in general are expected to possess. The MAP framework (Multidimensional Adapted Process Model of Teaching) [35] portrays a large set of educators' competencies from the knowledge base required for teaching and learning to cognitive thinking skills, social skills, personal orientation, and professional well-being. The MAP framework highlights the many competencies beyond the frequently cited content knowledge and pedagogical content knowledge that computing educators also need in their work. For instance, educators' social skills or professional well-being competencies are on display in a classroom alongside their computing content knowledge. Social skills and professional well-being competencies in the MAP framework are well in line with the skill of handling emotions and care ethics discussed previously.

As students observe educators and may potentially emulate them, this work aims to support reflections on what computing educators do and do not model, in which situations and why. As educators may be unaware of some of their role modeling and may or may not intend to be emulated in this way [15], in our survey we also asked our participants to reflect on those aspects of themselves that are not as rational or planned, such as emotions.

With this work, we aim to encourage reflection among educators of all experience levels. Further, we aim to contribute to an understanding of what is modeled and to offer insights gained into the challenges and opportunities for role modeling that can inform computing educators and different stakeholders, e.g. directors of studies and study program coordinators, and point towards systemic barriers and scaffolding. The results may contribute to the discussions on teaching culture in computing departments and suggest new intended learning outcomes and content for pedagogical training and support provided for computing educators. If within a study program different educators are modeling aspects outside the computing norm, e.g. caring for the impact of technology on society and the planet, the students are provided with a larger range of disciplinary identities. This can broaden the students' view of what it means to be a computer scientist and how the students perceive themselves. Besides contributing to student diversity and equitable access and participation, through role modeling, computing educators can broadly increase the relevance of computing education for sustainability.

Our research questions (RQs) were:

(1) What emotions, ways of caring, and other parts of role modeling do computing educators in higher education think they show or do not show? Do they vary according to their level of experience?

(2) What situations or contexts do educators describe in which they show/do not show emotions, care, and other parts of role modeling?

(3) What reasons do computing educators give for not showing emotions, care, and other parts of role modeling?

In the remaining sections of this paper we introduce the background literature on role modeling, followed by the details of our research approach. We then present our findings and the discussion, along with implications for teaching, our contributions, limitations of this project, and pointers for future work.

2 BACKGROUND

While role modeling has been discussed in computing and engineering education, many studies tend to assume a shared understanding of the term role model between authors and readers. However, there may be differences between researchers in how they understand role modeling, and how the participants in these studies may interpret the concept. This can even occur in the same research team, as experienced during the writing of this paper). This is because role model as a term is loosely defined [12, 13]. We start this section by defining role modeling according to Grande [15], that based on the literature on role modeling and their own research states that a role model is *"a person who embodies a seemingly attainable achievement and/or an aspect (competency, character attribute, or behaviour) which, through its imitation or avoidance, may help another individual achieve a goal."* (p. 3).

In this section, we have first presented a synthesis of the literature that denotes the relevance and need for this work given the social constructions of computing and computing education. Then we expanded on a thorough presentation of the different theoretical aspects of role modeling considering Grande's framework [15], and theories of care, emotions and competence that shape the design of this study.

2.1 Social constructions of computing and computing education: norms, values, and identities

Research on norms, values, and identities in computing and engineering education suggests engagement in these fields of studies is oriented towards the technical, mathematical, logic and rationality, reductionism, and abstraction (context-independent). Much of the research has been conducted within gender research or addressing under-representation of women [32, 44, 63]. Reductionist framing, the narrow focus on mathematics and technology, is seen as masculine traits, and computing and engineering are aligned or co-produced with norms of hegemonic masculinity. Computing is constructed as something that centers around the computer or the machine. Stereotypical ways of engaging in computing, e.g. programmers as hackers, sitting with the computer until late at night, are encouraged, and those ways of engaging are more accessible to male students [32, 43, 54]. Ottemo [43] points out that the "nerd image" is not idealized by all students but still has a strong influence

on students and educators. Ottemo, Berge, and Silver [44] reviewed a diverse body of research on gender in engineering education. They referred to feminist critiques of science and technology in general and its critiques of the prevailing emphasis on objectivity, universality, and rationality. This emphasis creates little spaces in which to engage in personal well-being.

Role models can represent under-represented ways of being. They can make visible certain identities, such as being of a marginalized gender, race or ethnicity, from a non-academic background, or intersections of these. Here, we have focused on educator's representation of ways of being and doing (or lack thereof) in the discipline that are under-represented and that are important to demographics that are under-represented as of now, e.g., women. This applies both to ingroup students (those who share group membership with the role model) and outgroup students (those who do not). We drew on research on care and emotions as capturing aspects that lie outside the norm of objectivity, universality, and rationality, as will be argued in the following section describing the theoretical framework.

However, we also want to keep sight of the complexity of role modeling, particularly how norms and social contexts shape and limit the effect of role models. One of the student's goals may be to be recognized as a computer scientist, and so they may look for professionals who represent ways of being a computer scientist that are acknowledged by others and with whom they can identify. In a teaching setting, an educator may represent ways of participating in computing that are perceived as outside the norm and that are not legitimate to emulate by the student [17]. For example, Peters' work on participation in computing suggests that engaging with human aspects in computing is socially perceived as outside the scope of computing, or easy to learn [47, 48]. In this study, a participating educator who showed enthusiasm for human computer interaction was questioned and seen as probably not capable of programming. This educator therefore could be a negative role model (someone to avoid becoming if the student's goal is to become "a real computer scientist"). A potential positive role model is someone who is a "real computer scientist".

Context matters, and science and technology need to be understood as sociocultural activities inseparable from the time and place of their production. Sociocultural norms and values are established in the structures and social dynamics and among educators and students. They are powerful, forming and constraining students. A longitudinal study following computing students through their first three years of education has shown how education forms students into technical, "back-end" problem solvers, which is doing the invisible, that which is hardly noticeable to others, as the students explain it [47, 48]. Students gave up their original intentions to engage in computing to connect computing with other interests such as politics, art, or helping people, and focused on gaining technical competence. Ottemo's [43] ethnographic study of two engineering programs, one being a program in Computer Science and Engineering, suggests that education fails to subjectively engage students. Students develop an instrumental approach to education and focus on getting a degree rather than engaging in the subject matter in meaningful ways. Much of the previous gender research has argued that dominant social constructions privilege the male students or students who enter the study program with a passion

for computing that help them persist in an otherwise instrumental dis-engaging education. Ottemo argues that the subject position of a student who accepts the instrumental framing of education could also be associated with the opposite, a female student.

The binary approach to discussing gender in (science and technology) education has been criticized, and queer perspectives on science and technology are being called for [23, 68]. We envision our work leading to new insights into social construction in computing education.

Today's sustainability challenges give further reasons to rethink prevalent norms and values in computing and engineering education. Sustainable computing has become an established research field in the past few years. Here, existing computing norms and values are also discussed and critiqued in ways that overlap with gender research though seldomly connecting to gender research and gender. For example, Easterbrook [7] critiques the focus on computational thinking as reductionist and suggests moving to systems thinking, while acknowledging that technology, human behavior, and environmental impacts are tightly interrelated.

With this work, we explored what educators attempt to model and increase awareness among students. We analyzed their reflections with theoretical lenses that shed light on that which is marginalized and of importance for under-represented populations in computing. We have drawn on theories of care and emotions, and made use of frameworks on role modeling [15] and professional competencies [53].

2.2 Theoretical frameworks

Our theoretical considerations start with the framework for role modeling proposed by Grande [15], which provides a way to discuss what is modeled. To be able to discuss in more nuance what educators in computing think they model, we have drawn from theories of care and emotions, and other frameworks for competencies. As we explain, care and emotions are closely related and together are a focus for this work on educator's role modeling. Our work is situated in the computing education context, where educators are potential role models who may or may not represent the norms and values in the discipline. Our goal is to capture how much of the educators' purposeful practices span the role modeling of care, emotions, and competencies in computing education.

2.2.1 Role modeling. The term role modeling is used in various contexts with different goals, thus being loosely defined [13]. For the context of engineering education and identifying the need to have a common language to describe role modeling in more nuanced ways, Grande proposes a framework [15] based on their exploration of the controversies and theories spanning role modeling and supported by their own research. While the purpose of this framework is to provide scaffolding for reflections on any kind of role modeling within engineering education, it is particularly targeted at the educators' perspective as role models for their students. The elements of the framework are composed by "*who* - mainly - participates in the modeling, *what* the model may embody, *how* awareness and intention play a role, and perception of the modeling by others." (p.3, emphasis added).

Considering the "*who*" participates in role modeling, there are two main actors: the person being observed (the role model) and

the person observing them (the emulator). The emulator has a goal, and the role model represents a way to achieve that goal [13]. A role model can mainly be perceived in two ways: as an example to be followed (positive role model) or avoided (negative role model). When someone is referred to as a "good" role model, this may mean that they are a positive role model or that an individual not emulating them still considers them as worth imitating, an endorsed role model. When someone is a "bad" role model this can be perceived as detrimental or negative. An example in computing would be a student (emulator) observing successful professionals in the field (positive role model) and a peer student failing a course (negative role model). However, there are nuances to these two broad cases. The emulator will have different role models at different career stages [12]. In addition, the role models and emulators can be within the same field or in different fields.

In terms of "*what*" is embodied by the role model, these can be considered achievements (subjective or objective) that the emulator values in some ways, or elements that the role model embodies that are inherent to the role model themselves (e.g. characteristics, attitudes, behaviors, competency). Sometimes the division between these two areas is blurry. Emulators may not be fully aware of why they observe and imitate a role model, or they may struggle with the potential mismatch between their goals and how role models representing them are not recognized as, for example, competent. This is particularly relevant for our research, since we are putting non-traditional dimensions of computing education such as care and emotions to the fore for computing educators to consider.

In terms of "*how*" one can role model, Grande pays attention to intentionality and perception. They state that while the emulator makes an active and conscious choice (emulating or avoiding), the role model has no agency and may not even be aware of their being a role model [15]. This aspect of intention is unique for role models, "we can look at how aware the model is of what they are embodying, and whether it is their intention to have that aspect or achievement imitated by others." (p.5) Grande refers to the dimensions of awareness and intention, again as four combinations presented in Figure 1. In the horizontal dimension is the intentionality of the role modeling while in the vertical dimension is the awareness dimension. As shown there are multiple combinations between the level of awareness and intentionality.

Within the considerations of this framework, the "who" of our work considers computing educators in higher education as role models and students as potential emulators. For the "what" is being emulated we are expanding the traditional definitions, and while we include competencies, we are also expanding to non-traditional dimensions of education, in this case care and emotions. Finally, for the "how", we found that through this study we were considering elements that the role models were aware they were modeling. In fact, participants often reported on this being their first opportunity to think about this particular intersection, yet the design of our survey invited awareness of the role models' actions.

2.2.2 Theories on care. Ethical theories of care capture different aspects of what is lacking or marginalized in computing and engineering education [49, 60]. They emphasize context, relationship, and attentiveness to others' needs [76], which are traditionally associated with femininity, and which stand in opposition to what
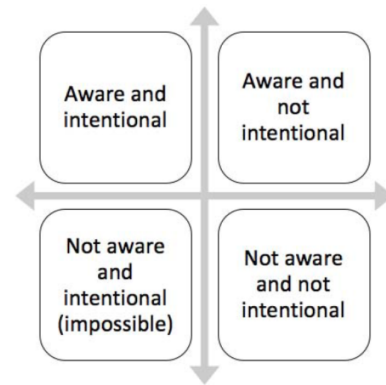
Figure 1: Possibilities of awareness and intention of the modeling by the role model. Source [15, p. 6, Fig. 2].

is found to be dominant in computing and engineering education, i.e. its abstract nature and context-independence, and the focus on technology as opposed to the human programmer and users. There are several ways of conceptualizing care. The feminist care ethics theory, developed by Tronto among others [76], has been proposed for engineering [60] as an alternative to the existing masculine ethics in engineering, in which traits such as independence, depersonalization, and intellect are valued over interdependence, connection, and emotion [60].

Care, within feminist care ethics, involves an emotional relationship between the one caring and the one cared for. Care 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" [9, p.40]. Care emphasizes values such as attentiveness, responsibility, nurturance, compassion, meeting others' needs [76] and as such includes emotions. Care is associated with femininity and can be seen to stand in opposition to the masculine computing culture. The mapping of care to femininity and computing to masculinity is also problematized [23, 78]. Noddings [38, 39] argues that care is not a feminine condition but is a human condition. There are also alternative conceptions of care, as reviewed by Osberg [42] in her conceptualization of education caring for the future, and arguing for more open understandings of care. Within computing and engineering education, feminist care ethics has been promoted [18, 36, 49].

Mariskind describes educators' care in higher education, considering that "while care can be understood as a disposition, an ethic or a practice" [33, p. 308], Mariskind's work focuses on practice. The four interconnected phases of care identified by Tronto [77] apply to teaching in higher education:

- Caring about: here the educator recognizes that care is needed (for others, one's environment or oneself).
- Taking care of: the educator takes the responsibility of the care and considers how the needs identified can be met.
- Care-giving: the caring is done, i.e. the needs are addressed, to the extent that there are competence and resources to provide it.
- Care-receiving: confirmation that the needs have been met, with the one cared for signaling this in some way [33].

In other words: educators identify that they, their students or others (living or nonliving) in their environment have a need, so that the educator reflects on how to meet this need and acts on their decided approach to this instance of care; then there is an evaluation of whether this approach was successful, i.e. the need was met.

For all these steps to take place, the educator needs empathy, responsiveness, risk-taking, critical thought, action, etc., i.e. traits associated with more than one gender [33].Notice that some of the needs are not necessarily directly identified by the educator, but rather communicated to them by others, e.g. certain competence that needs to be achieved by the student as stated in the curriculum, as a need that someone other than the educator has identified for the student and that the educator needs to be involved in addressing; while identifying other needs may require individual observation by the educator, e.g. noticing that a student is struggling with a difficult personal situation affecting their studies and needs support. Thus, different types of competence for the educator are needed to care for these various needs [33]. A range of actors needs to be considered when looking at care, from a political perspective too, not forgetting the role that higher education institutions have: if the educational system does not appropriately care about and for students, then educators may become care-advocates, using their positions to demand change aimed at meeting the students' needs [33].

2.2.3 Theories on emotions.
Emotions are one aspect of the teaching and learning process that all actors experience and may not have space to express in the social construction of computing as a purely rational undertaking. Emotions have been defined as "multifaceted phenomena involving sets of coordinated psychological processes, including affective, cognitive, physiological, motivational, and expressive components" [46]. As such, emotions are potentially a part of performing care and they make certain caring relationships more likely, such as caring for machines if a person enjoys programming or repairing hardware components. In this work, we ask educators about emotions and care and that way get insights that we believe are related. We further delimited our focus to higher education computing educators' emotions that are related to teaching or engaging in computing.

Educators' own teaching-related emotions are a less researched topic, although there have been some recent papers on higher education educators' emotions. Hagenauer et al. [19] studied German and Australian higher education educators' perceptions of appropriate emotion display, finding that educators perceived open expression of positive emotions as an integral part of teaching, whereas negative emotions were controlled more based on the educators' understanding of professionalism. The results also suggest that both the cultural aspects and the quality of the relationship between educators and students had an impact on what educators regarded as appropriate ways of displaying emotions. Another study focusing on educators' experiences of emotions by Kordts-Freudinger [21] found that there is a significant emotional component of the approaches to teaching. The results suggest that educators' positive emotions are related to the student-oriented teaching approach and negative emotions (moderated by cultural-educational context) are

related to the content-oriented approach to teaching. The educators' emotions also affect students' views on teaching. Toraby and Modarresi's [75] results show that there is a relationship between educators' emotions and students' views on educators' pedagogical success. For instance, enjoyment that educators displayed was the best predictor of students' views on educators' pedagogical success. Students also experienced that displaying pride and enjoyment were ways to motivate the students. As a summary, educators' emotions, how they are displayed and observed, are related to many things from teaching approach to students' experiences in the course. However, it is important to note that "simplistic conceptions of negative emotions as bad and positive emotions as being good should be avoided because positive emotions are sometimes detrimental and negative emotions such as anxiety and shame beneficial" [45] (p 103).

The fact that computing and engineering are socially constructed as rational endeavors might also explain why there has been so little research on emotions in computing and engineering education. This is changing. For example, there is an ongoing research project on emotions in engineering education in Sweden, and preliminary results of a scoping review on emotions in engineering education have been published [28]. As for care, being emotional and showing emotions is traditionally associated with women and might go against computing culture. Yet, again, emotions and care are mapped on to social binary constructions of female/masculine, which is argued to be problematic [23, 78].

The lack of research on emotions in computing education has also been identified in the context of sustainability. A recent intervention study by Eriksson et al. focused on anxiety related to climate change and other sustainability challenges [8]. The study suggests that engaging with emotions and being emotional was appreciated by the students, even engaging with discomforting feelings of hopelessness, anxiety, or sadness.

In the broader field of research on education for sustainability, emotions are being studied and discussed as important. Young people are increasingly concerned about society and the future and can feel hopelessness. Education should be a place that engages with the "impossibility of sustaining our contemporary modern-colonial habits of being, which are underwritten by racial, colonial, and ecological violence" [72]. Such engagement is likely to evoke discomforting emotions. One crucial role of education may be to cultivate "active hope" [30] or "critical hope" [40], not by spreading naive optimism, but "by showing that another way of being is possible, by encouraging trustful relationships and by giving young people the opportunity to concretely work together for change".

2.2.4 Computing competency frameworks.
The competence concept is often used to capture what being professional entails. For instance, the Organisation for Economic Cooperation and Development (OECD) through its International Student Assessment (PISA) uses the concept to describe what is essential to strengthen through education in order to prepare globally competent individuals [10]. The OECD-PISA framework's definition of global competence highlights aspects of human behavior and qualities within a large cultural context, inclusive of "responsible action toward sustainability and collective well-being" [10, p. 4]. ABET uses competence to illustrate learning objectives that institutions seeking accreditation

need to provide evidence that their students achieve [52]. Recent ACM and IEEE-Computer Society curricula specifications are partly based on the competence concept. Competency frameworks, and other descriptions of competence, are typically based on seeing competency as consisting of three components, 1) knowledge, 2) skill, and 3) disposition (or attitude), in a specific context (for a specific task). The interdependence of these components draws attention to skill development and cultivation of personal characteristics and behavioral patterns, complementary to acquisition of technical knowledge in an educational environment, as well as in the workplace, on one's career pathway, or in other community and life experiences.

There have been efforts to define frameworks for computing competency based on this structure, not least during two ITiCSE Working Groups (in 2018 [11] and 2021 [53]). One important reason for these efforts is to broaden the understanding of what computing education could be, and to design learning environments that support the development of competencies in a holistic way. Such frameworks give structure and a formal discourse for addressing the dispositional aspect of being professionally competent. This aspect has been termed soft skills, generic skills, and transferable skills, to name a few, and has led to a non-academic impression of them. The ambition is to raise awareness and improve the status of discussing the disposition aspect, but more importantly to convey the value of having a holistic view when addressing issues in a competent manner.

In this paper we have chosen to use the competency taxonomy referenced and discussed in the 2021 ITiCSE working group report to conceptualize professional dispositions [53]. It is mainly the definition of dispositions that is of interest in our context of modeling care, emotion, and other dispositions in computing education. Proposed in the *Education for Life and Work* report of the National Research Council of the U.S. National Academies of Sciences, Engineering, and Medicine [37], the competency taxonomy reflects the view that knowledge and skills are intertwined and the domain of competence is not reduced to the cognitive dimension. Thus, what the taxonomy categorizes as intrapersonal and interpersonal competencies maps to dispositions. Intrapersonal competencies are defined as "the capacity to manage one's behavior and emotions to achieve one's goals (including learning goals)" [37, p. 3] (cited in [53]), and include dispositions such as flexibility, personal and social responsibility, self-direction, self-reflection, integrity, and citizenship. Interpersonal competencies are defined as "expressing ideas and interpreting and responding to messages from other" [37, p. 3] (cited in [53]) and include dispositions such as empathy, perspective-taking, conflict resolution, persuasion, and social influence with others.

3 RESEARCH APPROACH

In this exploratory survey study [71] we were particularly interested in gaining a better understanding of what emotions, ways of caring, professional competencies, and other parts of role modeling computing educators in higher education think they show or not show as they interact with their students. The survey had both open and closed questions, i.e., we obtained complementary quantitative and qualitative data on the same topic to understand the research problem better (role modeling). First we analyzed the quantitative and qualitative answers separately and then looked at all the results together in the discussion to see what we could say about role modeling and how our results corroborated the literature.

3.1 Survey

We used a survey to collect educators' views on what emotions, ways of caring, and other parts of role modeling educators show (or do not show), in which situations or contexts this happens (or does not happen), and for what reasons. We were unable to find a previously validated survey that would provide data relevant to our study and therefore we created the survey questions based on the role modeling framework [15], care ethics, and previous literature on the topic (Table 1). The whole survey is shown in Appendix A. We distributed the survey internationally in June 2022. The call for participation was posted to the SIGCSE-members and other computing educators mailing lists, social media, as well as sending to each of the research team members' institutional mailing lists.

We invited people with teaching duties in a computing-related subject in higher education to participate in the research study. In the title of the survey (*"Educators in computing as role models for their students"*) and in this paper when we use the term "educator" we refer to anyone with teaching duties, regardless of their experience level. This includes lecturers, instructors, teaching assistants, professors, faculty, and many other titles that teaching positions are given depending on the institution's culture. These teaching duties are in computing-related courses in higher education, where "computing" has been used as an umbrella term referring to various sub-disciplines dealing with digital technologies, e.g. computer science, software engineering, or information technology.

The survey contained both Likert type of closed questions as well as some open-ended questions. More specifically, we asked about the respondents' teaching background, such as how long they had been teaching and the kind of teaching duties they performed. Here "duties" included giving lectures, seminars, etc.; creating material for teaching; assisting students in lab sessions, tutorials, or any setting where they can ask for help; supervising students with projects (bachelor's/master's thesis, etc.). We also asked how they interacted with their students (in-person teaching; online/remote teaching; supervision meetings, office hours or equivalent support-based sessions; learning management systems; email; messaging services; social media, or other ways). The survey continued with three questions that were related to the educator themselves as a role model. In this section, we asked respondents how they show their students care, emotions, professional competencies and other aspects of them as humans. We did not define or explain care, emotions or competencies, but instead left it open to the respondent to interpret and make sense of, to open up for a variety of perspectives.

We framed our work on the *"who"* and *"how"* components of role modeling as educator in light of Grande's role modeling in computing framework [15] as described in Section 2. Thus, in terms of who we studied as a potential role model and their potential emulators, in this study we have focused on 1) educator in computing and student in computing, and 2) educator in computing and student not in computing, where we defined educator "in computing" as someone with teaching duties in a computing-related course.

We did not look at the role model's (the educator's) educational background or current employment. The potential emulator (the student) was taking a course in computing, or being supervised in this area, but we did not make a distinction between whether this was an isolated case in their studies or the main area for their degree. As the survey questions asked about the educator's perception of what they themselves showed, in terms of awareness and intention of role modeling, we focused on awareness: what the role model identifies as potentially (whether the educator has the intention or not) emulated or avoided by the students.

In terms of the *"what"*, we stated that our main focus was on role modeling of care, emotions and professional competencies. While the framework provided a definition of role modeling that inspired our work, we did not share this definition with the survey participants. The survey was distributed and contained in the title and instructions the term "role model". But in the questions, we avoided this wording. Instead, we asked participants what they "showed" in terms of care, emotions and other parts of themselves, i.e., no definitions were provided for "role modeling", the various kinds of emotions, care and professional competencies, as we were interested in the different interpretations the participants could give them.

As mentioned above, we did not define "care" for our participants. Instead, we tried to refer to the phases of care. For the main question on care, we used the phrasing: "How often do you show your students what you care for, as a part of teaching or engaging in computing?", which mainly refers to the second stage of care, taking care of, i.e., considering how to meet the needs of the cared-for (oneself, other living species and other non-living species). Then the different options within this question were phrased as "Taking care of X", e.g. "Taking care of yourself (well-being)". Here "taking care of" can be interpreted similarly or as focusing on what is shown, the action(s) to meet the needs for care, i.e., the third phase of care, care-giving. By using these different phrasings, we hoped to capture various ways that care is perceived and enacted by educators.

Participation was voluntary and could be withdrawn at any time without giving any specific explanation. We did not ask any questions that might have been interpreted as sensitive or personal data. Of the team of ten international researchers, only one of us had access to the responses. This person ensured that the data shared with other researchers did not contain personal data, including names, geographical locations, etc. that some respondents might have shared in their open-ended answers (vague mentions of age and legal gender were kept). Similarly, if the respondent had given their email address for possible future research purposes, this information was not connected to the pool of answers at this point of the research project to ensure the data remained anonymous.

All researchers in the team are trained in ethical handling of research data, and we stored the anonymized data on a server belonging to Uppsala University, Sweden, the institution responsible for the personal information.

3.2 Data Analysis

We created subgroups for the quantitative and qualitative analyses according to our expertise and interests. One subgroup was in charge of quantitative analysis of the data, a second subgroup was in charge of the qualitative analysis of care dimensions, a third subgroup was in charge of the qualitative analysis of emotions, and a fourth subgroup was in charge of the qualitative analysis of other parts of role modeling.

3.2.1 Quantitative Analysis. Quantitative analysis of valid numerical responses was conducted through descriptive statistics focused on the frequency and basic statistics of the responses. The distribution of the responses was considered for the methods used and the interpretations taking place. Frequencies were preferred for participants' experience distribution, while descriptive statistics were used for teaching duties and interactions. Mean scores for the care and emotion dimensions were estimated for the full sample of respondents. Since the options to our Likert scale questions included a "Do not know/not applicable" option, preliminary data preparation had to take place before the execution of quantitative analysis. Responses selecting this option were considered legitimate, so no imputation took place. Therefore, the final sample size varied depending on the question under analysis.

Comparisons between groups with various levels of teaching experience were conducted through Kruskal-Wallis group comparisons, which is a non-parametric alternative to the ANOVA test and was found to be suitable for the type of data derived from our survey. We performed group comparisons for each of the five dimensions of care and each of the six emotions in the survey. Because some of the dimensions of care and emotions aligned with each other we grouped them together for additional analysis. In particular, the dimensions of care were divided between those related to living agents (i.e., self, others, other living, planet) and non-living (i.e., technology).

Since the split of the original items among these groups was not uniform, we opted to generate standardized scores and subscores for per group. This standardization allowed for easier interpretation, since scores are normalized to a range between 0 and 1, rather than having different ranges in their units.

We created a Care Score, which was calculated as the sum of all the caring items divided over the highest level of expression of care (i.e. all the time, all dimensions – see Equation 1). Therefore, the score is a variable ranging from 0 to 1 where 1 reflects the highest level of caring across all dimensions. In a similar fashion, we built two sub-scores: (1) Living-care Score, the scaled responses associated with one's ability to show care to living beings, as presented in the following: a (yourself), b (other humans), c (technology), d (other living species), and e (the planet) (see Equation 2); and (2) Tech-care Score, the scaled response associated to care for machines (i.e. item c).

$$CareScore = \frac{a + b + c + d + e}{25} \tag{1}$$

$$Living_{Care}Score = \frac{a + b + d + e}{20} \tag{2}$$

$$Tech_{Care}Score = \frac{c}{5} \tag{3}$$

In a similar fashion, we also created scores to facilitate the comparison between different subsets of emotions. This division follows established contemporary emotions research, which describes how emotions are often compiled in the construct of affect. As such, emotions and moods can be categorized into the

Theoretical framework / previous research	RQs	Survey Questions	Data Analysis
Care theories [33, 38, 77]	All	Q5	Qualitative and quantitative
Emotions theories [45, 46]	All	Q6	Qualitative and quantitative
Professional competencies framework [53]	RQ1 (mainly)	Q7, Q8, Q9	Qualitative
Role modeling framework [15]	All	All	Qualitative

Table 1: Correspondence of theory and frameworks (with main references) with research questions, survey questions and the type of analysis conducted

type of affect they elicit, with positive states (e.g., pride, enjoyment, satisfaction) eliciting positive affect, and negative states (e.g. anger, anxiety, frustration) eliciting negative affect states [45]. Therefore, we divided the emotions considered in this study into positive (a.fulfillment, b.enjoyment, c.hope, d.pride) and negative (e.confusion, f.frustration).

The sums for total emotions and the positive and negative emotions subgroups were also normalized to facilitate the interpretation of the results. Equations 5 and 6 illustrate the calculation of Positive and Negative emotion scores.

$$EmotionsScore = \frac{a + b + c + d + e + f}{30} \qquad (4)$$

$$Positive_{Emotions}Score = \frac{a + b + c + d}{20} \qquad (5)$$

$$Negative_{Emotions}Score = \frac{e + f}{10} \qquad (6)$$

It is important to notice that while fixed numbers were used here to describe equations 1-6, the actual denominator was adjusted per participant based on the actual number of valid responses (i.e. not "Do not know or want to answer/Not Applicable") that they provided within a particular group and subgroup. These scores were also analyzed through descriptive statistics and group comparisons. Two authors cross-validated their quantitative results using R and Python.

3.2.2 Qualitative Analysis. We used thematic coding analysis based on [4] to analyze responses to the open-ended questions. The aim of our qualitative analysis was to provide a rich thematic description of the reasons for and situations in which instructors showed (or not) emotions, care, or other parts of role modeling. We took a semantic approach to the analysis of the open-ended questions accepting what respondents said without trying to make further interpretations of the underlying assumptions. For the care and emotions related answers we applied inductive analysis and for the competencies related analysis, we applied deductive analysis as relevant previous research on the topic provided categories. We conducted the analysis using a spreadsheet accessible online through one of the institutions, as using more advanced tools such as Atlas.ti for a shared project proved to be challenging in a group of researchers from several institutions. The analysis resulted in rich descriptions of reasons and situations which we then put into a wider context (see Section 6).

We divided the analysis of the qualitative data between the researchers responsible for the three open ended questions on care, emotions, and competencies. As a first step of the data analysis, researchers who were allocated care and emotions answers read

the responses to the open-ended question(s) allocated to them to familiarize themselves with the data. As a second step, researchers read a subset of data (30 answers) again and did an inductive analysis to see what kinds of reasons and situations the respondents mentioned in their answers. The inductive analysis on the reasons and situations was done in small teams of two or more researchers, which enabled joint decisions on how to interpret the answers and which would be the descriptive category labels. The second step of the analysis resulted in preliminary coding labels for the data on care, emotions and competencies. The researchers analyzing the care and emotion data shared the preliminary analysis with each other, discussed the differences in approaches to analysis of data sets, and helped each other to harmonize themes where possible. At this point the two groups also decided how they would analyze the complete data sets. During the third step of the analysis the groups analyzed the rest of the data set using the preliminary themes found in step two. The groups then split the analysis of the remaining data sets between themselves and completed the coding using the agreed upon thematic labels. However, as this was an inductive analysis process, we were open to modifying and fine-tuning the themes further if the data suggested so. All modifications were based on the data and discussed with other researchers working on the same question. We did not calculate inter-rater reliability among researchers, as the analysis process was collaborative. For the most part, we did the qualitative analysis in groups of two to three people or the researchers discussed and negotiated with each other frequently what the essence of the accounts was.

Researchers who focused on competencies and other kinds of role modeling (mainly as answers to survey questions 7 to 9), conducted a deductive analysis by identifying in the responses professional competencies as categorized in [53]. Data that did not fit this classification was analyzed using a similar approach as the subgroups on care and emotions, in coordination with them.

3.3 Positionality statement

We present our positionality in terms of the relationship of our identities and our motivation for engaging in this research project, the way we see knowledge generation and creation, the methods we select, and how we communicate our results, as proposed by Secules et al. [70].

We are a team of computing and engineering education researchers who envision a culture shift in computing through positive role modeling that embraces the humanization of education. We all have experience teaching in our fields and have become aware of our own impact as role models in various ways including those in our teaching, advising, and mentoring practices. We engage in

this research enterprise to advance the establishment of a common language to discuss role modeling as a relevant element of computing education. In addition, we envision that the role modeling of important human dimensions, in this case care and emotions, which have been traditionally neglected from educational spaces, will invite a more thorough reflection and discussion in our field about what is truly involved in the educational processes. This becomes more relevant as the experiences of the new generations of students have been significantly influenced by societal issues such as climate change, and elements that directly impact their well-being, such as the COVID pandemic; we believe this is a critical time to scrutinize what is modeled for students taking computing-related courses through their educational experiences, and for educators to reflect on their impact as intentional or unintentional role models. In addition, as computing is a field of technological advancement and technology is not value-neutral, it is important that we reflect in the community which values, such as the recognition of care and emotions, are or are not present in the education of the next generations of computing professionals.

The group is composed of a majority of women, but also includes men who identify as allies of gender equality and non-binary scholars. The racial composition of our group includes members of racial minorities as defined in the U.S. context. Some of the group members are immigrants in the countries where they work. In addition, members of our team have lived with mental health conditions, and have identified the challenges and existing research in the field at this intersection. Therefore, we are all informed by the experience and/or by the research that highlights the challenges of gender, race, and being a minority in computing and are committed to contributing to the advancement of the field as a more equitable and just space. We believe that by expanding the discussion of care and emotions, we are setting an important step for advancing the discussion of more specific issues of marginalized groups. As care and emotions have been traditionally seen as feminine traits, we also aim to challenge such a narrative by bringing care and emotions to the fore for educators and exploring how these traits are suitable and desirable to be expressed for people of all backgrounds.

3.4 Validity and trustworthiness

The questions in our survey were based on the previous research literature on role models, care, emotions, and professional competencies (see Table 1). The survey was distributed internationally to collect answers from several countries and institutions, after pilot testing it and applying the feedback received from educators in the authors' networks. Even though we did not ask for the respondents' nationality or institution in the survey, this could mainly be deduced from the institutional email addresses that were voluntarily submitted by some respondents to be contacted for future work. That is, for some participants, the one researcher who anonymized the responses (when needed before sharing the data with the rest of the group) noticed that respondents came from several different countries and institutions.

Although we received 199 responses to our survey, we acknowledge the possible bias in our sample; it is likely that we only received responses from educators who believed they could be role models or who at the very least were interested in some manner in this

topic and were willing to share their thoughts with the researchers. Those who did not believe that they were or could be role models, or had no interest, would not have participated in our study.

We took several measures to enhance the quality and trustworthiness of the qualitative data analysis. We conducted the data analysis in smaller groups of two or more researchers to enable discussions on the choice of tests and the analysis methods. As we conducted the qualitative thematic analysis on the open-ended answers, we did the analysis incrementally by reading and rereading the text several times and discussing the emerging themes with other researchers to make sure that the themes corresponded with the data and were named so that others would understand them. That is, we employed prolonged engagement with the data, utilized investigator triangulation, and were aware of the possible theoretical and experience-based point of view that each researcher might bring to the analysis process (see our positionality statement). These are well known measures to enhance and ensure the trustworthiness in qualitative research (e.g.,[34],[29]) .

4 QUANTITATIVE RESULTS

We had a total of 199 valid responses. Many of the respondents were very experienced educators. Over 47% of them had 16 years or more teaching experience. Educators who had one year or less teaching experience were the smallest group (6.5%) in our data set. The distribution of survey respondents from our multinational survey in terms of their experience is displayed in Table 2.

Group	Years Teaching	Frequency	Percent (%)
1	<1 year	13	6.5
2	1-5 years	41	20.6
3	6-10 years	19	9.5
3	11-15 years	31	15.6
4	16 years or more	95	47.7

Table 2: Survey participants' years of experience distribution

Descriptive statistics (mean, standard deviation, min/max) for Q1, Q2 and Q4, are presented in Table 3.

| Statistic	Q1. Teaching Duties	Q2. Term	Q4. Interactions
Mean	8.71	3.77	11.79
St. Dev	2.30	1.39	4.31
Min	2.00	1.00	1.00
Max	11.00	5.00	18.00
Total Obs	199	199	199

Table 3: General statistics for opening survey questions

Q1's responses were calculated based on the number of teaching duties listed per participant. Q2's responses were categorized into 5 categories: 1: <1 year, 2: 1 to 5 years, 3: 6 to 10 years, 4: 11 to 15 years, and 5: 16 or more years (where the maximum term is 5). Table 2 presents the frequency of these responses. Q3. was not analyzed further as all valid observations had teaching duties in

computing-related courses. Statistics for Q4 were calculated by the number of interactions listed by participants. The analysis of Q5 and Q6 are presented in more depth in subsequent sections.

4.1 Care

The general question exploring participants' role modeling of care (Q5) was: *How often do you show your students what you care for, as a part of teaching or engaging in computing?* The following five dimensions were included in the choices: (a) taking care of yourself (well-being), (b) taking care of other humans, (c) taking care of machines/devices/technology, (d) taking care of other living species (plants, animals, etc.) and (e) taking care of the planet. Responses were collected using a five-point Likert scale ranging from "Never" (1) to "All the time" (5). Participants were given the option to mark "Do not know/not applicable" (0); as mentioned, such responses were considered missing values in our data and excluded from analysis. We performed an analysis of the distribution of responses; no significant deviations from normality were identified among the responses to different dimensions of care. The overall mean values per each care dimension are presented in Figure 2. Care of yourself (well-being) and care of others were the dimensions with the highest average scores among our participants, while caring for other living species and caring for the planet were the dimensions with the lowest average scores. The results of Kruskal-Wallis group comparisons were not significant for most of the care dimensions across the different level of experience. Only Care about Planet was statistically significant at the 0.05 level among the compared groups of experience (p-value = 0.002); for this dimension, groups with longer teaching experience had higher scores than those with shorter experience.
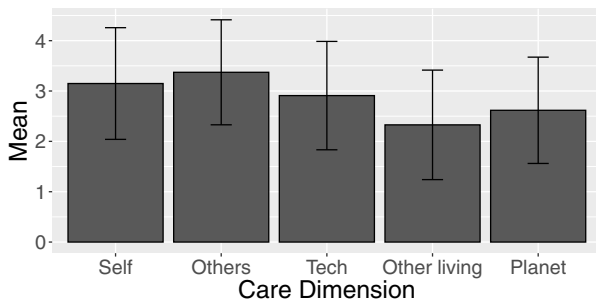
Figure 2: Average scores for each care dimension among the total of participants in the survey

Expanding on the exploration of the differences among educators with different levels of teaching experience, in Figure 3 we present the average *General Care* score, the *Living Care* score, and the *Tech Care* score by teaching experience group. It was evident that there is a trend in *General Care*, showing educators with higher experience reporting higher levels of care. When considering the subscores, the *Living Care* score had a similar trend to the *General Care* score, while the *Tech Care* score did show a peak among the group with 6 to 10 years of experience.
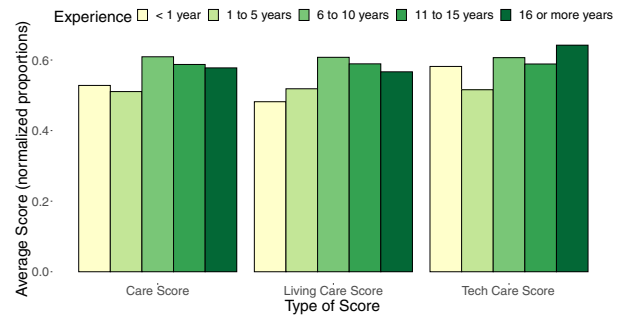
Figure 3: Mean Care Scores per participants experience

At the end of the Likert scale question about dimensions of care, participants were provided with the following question: *Please elaborate on two of your choices as follows: A) For one of those types of care where you chose "never" or "rarely", can you explain why you do not show it? B) For one of those where you chose "sometimes", "often" or "all the time", can you give one example of a situation where you showed it?* The answers to this question were the raw data for the qualitative analysis presented in subsequent sections. Here, in Table 4 we summarize the frequencies of actual comments discussing why or why not they showcase each type of care. The "All-encompassing" category reflects elements that fit with the proposed categories but are difficult to separate from each other. These responses were more concentrated in the reflections on not showing care. There were no mentions of reasons for not showing care for other humans. Reflections on showing care outnumbered those for not showing care in the self and others dimensions, while it was the opposite in the tech, other living species, and planet dimensions of care. The qualitative analysis dives deeper into the reasons and the ways our participants show or do not show these dimensions of care.
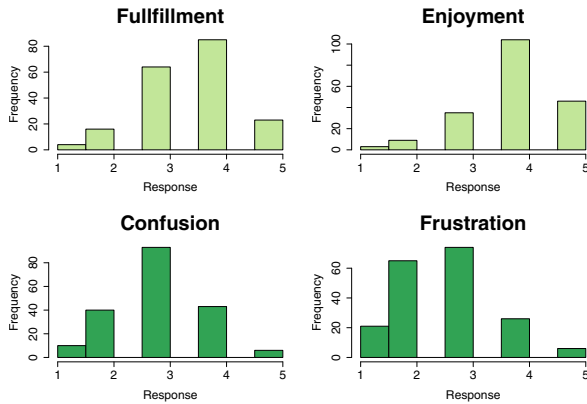
4.2 Emotions

The general question participants answered about emotions (Q6) was: *How often do you show your students your emotions that are related to teaching or engaging in computing?* Answers included the following emotions: (a) fulfillment, (b) enjoyment, (c) hope, (d) pride, (e) confusion, and (f) frustration. Responses were collected using a five-point Likert-scale ranging from "Never" (1) to "All the time" (5). Participants were given the option to mark "Do not know or want to answer/not applicable" (0). As mentioned, the latter was not considered in our analyses. We performed a general analysis of each individual emotion, and found that while positive emotions (such as fulfillment and enjoyment) were in general highly scored, negative emotions (such as confusion) were more centrally distributed. These differences are shown in Figure 4. These results support our literature-based decision of grouping positive (a-d) and negative (e-f) emotions.

We calculated the overall mean value for each emotion across our participants; Figure 5 shows these estimates. Enjoyment and fulfillment had the highest mean among the six different emotions, while what we labeled as "negative" emotions, i.e. confusion and frustration, showed the lowest means.

Count mentions for	Self	Others	Tech	Other Living	Planet	All Encompassing	Other
Showing	29	40	6	1	7	6	3
Not-showing	16	0	16	14	12	24	2

Table 4: Counting of instances showcasing reasons for showing or not showing each specific dimension of care

Figure 4: Raw distribution of participants' responses to two positive and two negative emotions
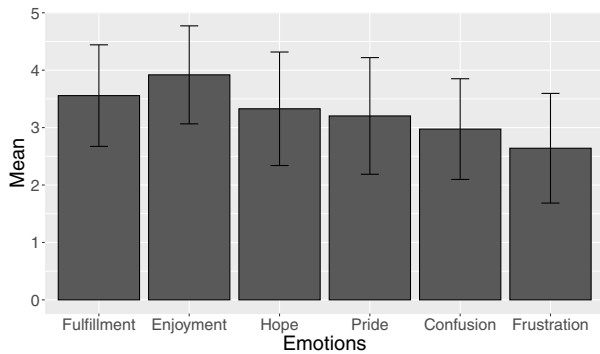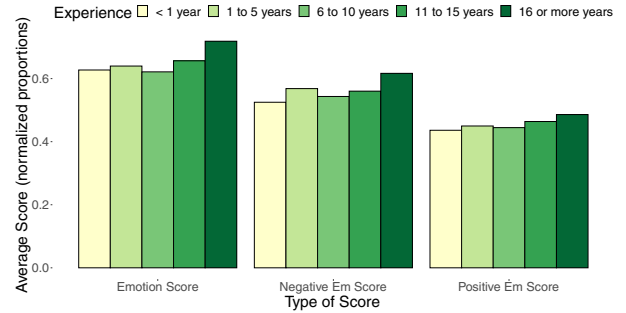

Figure 5: General means of the different emotions across all participants

We calculated differences in the raw mean by teaching experiences of our participants through Kruskall-Wallis tests, which showed no significant differences at the 0.05 level for any of the emotions between the different levels of participants' teaching experience.

In Figure 6 we have illustrated the scores' distribution by teaching experience; here, the overall lower scores for positive emotions are evident across all groups. There were no evident trends or relationships between experience and mean scores, with the highest emotion scores showing in the group with 6-10 years of experience. Statistical group comparison of scores between groups resulted in no significant differences for any score.

At the end of the Likert scale question about dimensions of emotion, participants were provided with the following question:

Figure 6: General means of the different emotions by teaching experience

Please elaborate on two of your choices as follows: A) For one of those emotions where you chose "never" or "rarely", can you explain why you do not show it? B) For one of those where you chose "sometimes", "often" or "all the time", can you give one example of a situation where you showed it? In Table 5 we have summarized the frequencies of actual comments discussing why or why not they showcase each emotion. The qualitative analysis dives deeper into the reasons and the ways our participants show or do not show emotions.

5 QUALITATIVE RESULTS

In terms of what is reported as role modeled (or not) in the open-ended answers, when using the lens of Grande's role modeling framework [15], we could observe that participants mainly focused on aspects (something inherent to the role model, such as a character attribute), while achievements (external to the role model, such as awards) received little attention, even though a survey question included a specific mention of the latter. When achievements were mentioned, they were mainly related to research achievements (grants, etc.) or having developed an identity, such as becoming a professional through industry experience.

Some text lacked the context for us to be able to tell whether the educator simply talked about role modeling or actually modeled that. For example, some participants wrote that frustration is valid and that it is valid to ask for help. While one can imagine different ways in which an educator can model frustration for the students, modeling asking others for help seems far less likely. In this case, frustration as valid is coded, while asking for help is not.

In this section we have reported the qualitative results organized in a similar way than the questions were asked in the survey. i.e., for instance, we have reported the reasons and situations for showing care for each specific dimension of care separately. We hope this choice provides the readers with a way to either focus on the results as a whole or zoom into various dimensions of care, professional competencies, or some emotions according to their interest. We

Count mentions for	Enjoyment	Fulfillment	Hope	Pride	Confusion	Frustration
Reasons for showing	50	15	13	22	26	48
Reasons for not-showing	2	3	7	9	19	40
Situations where showing	38	9	8	15	22	27
Situations where not-showing	0	0	0	1	3	6

Table 5: Counting of instances showcasing reasons and situations to showing or not showing each emotion

have reported on our qualitative findings analyzing the reflections on (1) how care is shown, (2) reasons for not showing care, (3) how different emotions are shown or not, (4) professional competencies and other kinds of role modeling that were reflected on.

The origin of each quote is indicated by the participant's assigned number in parentheses. Each of the quotes has been included verbatim, i.e. we have not corrected for grammar, etc., to provide readers with the version of the material analyzed.

5.1 Showing care

In general, there were quite different types of statements and descriptions of how care is shown. Sometimes they were very specific in ways that can be emulated, such as telling about caring, perhaps saying they do it but not very often, and not making a point to do so. For example, *"Taking care of the planet - not really the focus of my subject sometimes through example applications though."* (123)

In the analysis of *ways* of caring shown, we found many situations and reasons mentioned in the survey, whereas *reasons* for showing care were mostly not given. Below are some of the themes that emerged in the analysis of each area from the survey: (a) taking care of yourself (well-being), (b) taking care of other humans, (c) taking care of machines/devices/technology, (d) taking care of other living species (plants, animals, etc.), and (e) taking care of the planet.

5.1.1 Taking care of yourself (well-being). A few computing educators mentioned taking care of yourself during work hours, such as taking breaks or having a healthy snack, as in this quote: *"I always encourage my students to take holidays and breaks, and I let them know when I'm going on break and to take the time without guilt as it is more restful."* (172). Some people also mentioned work-life balance as an aspect of taking care of yourself, such as keeping weekends free and taking care of the family: *"I point out I try to keep weekends free of work, and that meetings have to sometimes be moved due to caring responsibilities"* (126). Others also described taking care of themselves by telling students about hobbies such as outdoor activities and activities done in leisure time (e.g., watching TV): *"I have a different Zoom background every day that is a reference to some pop culture leisure I enjoy (e.g. a TV show, movie, musician, or video game)"* (1).

5.1.2 Taking care of other humans. When carrying out the thematic analysis, five themes related to taking care of other humans were found: Taking care of Students; Taking care of Family; Taking care of Colleagues and Teammates; Taking care of Users; and, Taking care of Society. These themes are described below.

Computing educators described situations in which they care for students and recommended that students take care of themselves.

The educators modeled taking care of others by taking care of the students. Some examples of behaviors that the educators described are taking time off and not contacting students during off-work hours, as in this quote: *"[I] insist on the importance of rest and I make sure I don't contact students during nights/ weekends/holidays, so they can enjoy their time off."* (194). Interestingly, one educator described encouraging students to care for each other, and to listen to personal stories: *"I often ask students to check in with the people sitting near them about how they're feeling when they enter the classroom. By asking them to engage with each other's humanity, it builds community and shows everyone that checking in and listening matters."* (122).

Some of the educators revealed how they take care of family members and children, as in this quote: *"I have a four-year-old daughter and I often talk about needing to take care of her. (I also have her picture in my office and some of her drawings on my office door.)"* (51). Meanwhile, taking care of colleagues and teammates was described as a natural part of work in the survey responses. For example, *"I emphasize lots of caring for other students as part of collaborative learning / students personal learning journey. Helping others, what that can mean, etc."* 101) and in *"I usually try to have at least some elements of discussion around respect for nature and coworkers incorporated somewhere in my lectures"* (52).

Another aspect of caring for humans presented here is the accessibility of software and safety qualities as a way of taking care of the users. When teaching accessibility, computing educators in the study described talking about users and their needs, as in these examples: *"In user focused design, I begin [the] topic with [an] Alan Newell quote about designing for people with accessibility needs, designing something that everyone can use and why it's important everyone is included."* (144) and *"I work hard to convey that programmers should care for their users"* (28). When teaching safety, caring for the users is also crucial as a part of discussing new technology, such as facial recognition and deep learning: *"What I do try to put emphasis on is creating some awareness of the applications the tools they learn in the exercises can be used for and the dangers that come with it, i.e. facial recognition, people tracking, surveillance, bias in the datasets a lot of deep learning models are trained on, etc."* (5). Some of the participants also expressed that they talk about human hazards connected to software, as in this quote: *"I do talk about the fact that software can kill - plane crashes - and have huge costs - crashed satellites, etc."* (49).

Several of the respondents indicated wider societal concerns, although these are often expressed in general terms, lacking specific examples. However, in some areas, explicit mention was made of caring for society, such as reflecting *"on how technology interacts with society (and the environment)"* (59), and talking about equality

with students as in this quote: *"discussing tech and race and gender and so on becomes a natural part of the teaching process (e.g. correct handling of pronouns, change of master-slave terminology all become a chance to discuss the why)"* (60).

5.1.3 Taking care of machines/devices/technology. In the comments related to taking care of machines, devices, and technology respondents wrote about looking after lab machines and institutional equipment, such as in this quote: *"I often lend out equipment, and in that role we talk about the importance of being careful with the things, yet use them to the full extent."* (73). There were also comments about taking care of technical equipment outside the lab or equipment available to the general public such as in this quote: *"Taking care of computers comes up because I teach security and there is a need to maintain them up to date to reduce the chances of compromise"* (113). Notably, there was only one quote related to taking care of personal technology: *"Hopefully when they see how carefully I (un)pack my laptop and other electronic stuff in the class."* (65)

5.1.4 Taking care of other living species (plants, animals, etc.) As the quantitative results suggest, we found few examples of taking care of other living species. In the examples we did get, the computing educators described how they talked about pets and other animals in their profession or even brought the pets to class, as described in this quote: *"I might tell a story related to our dog and I sometimes bring her to class with me - the students love that."* (67). Or making jokes about caring for their pets: *"Looking after my dog (more than myself)"* (145).

5.1.5 Taking care of the planet. Some respondents stated that they display care for the environment, or sustainability more broadly, in certain ways. Several respondents said the topic is important and should be part of education. One of the respondents also noted that *"many of our students are interested in sustainability"* (47). When looking into how taking care of the planet comes up in teaching, it is described in the context of designing software, such as in this quote: *"Writing clear code: social and economic sustainability. Writing efficient code: economic and environmental sustainability. Designing user interfaces and systems with sustainability in mind"* (156).

The environmental perspective was brought in through examples and data used in teaching: *"I've only recently started using climate change as a topic/theme for data sets to use in some courses"* (126), and *"I've also used global warming data."* (104). Several of the quotes related to taking care of the planet were about energy and energy consumption such as in these quotes: *"For instance during a lecture on programming: an inefficient algorithm is bad since it uses resources that is bad for the climate."* (187), and in this quote: *"I do discuss regularly the energy cost of computer systems and give examples of what can be done about it."* (109).

5.2 Not showing care

The reflections on not showing care were never on caring for other humans (see Table 4), which may be the most accepted type of care. There were a few examples stating that care for certain aspects is not shown - or rarely shown - and should be shown more. For example, well-being was reported to be on the agenda to be included in education *"as there is increasing concern about mental health and holistic approaches, but it hasn't yet been actioned on the ground and*

most discussion takes place with professional services colleagues rather than with academics. There is a need for more joined-up thinking in this respect." (42). Several respondents said that care for the environment should be part of computing education but is not currently. On the other hand, we found a few strong statements that care for machines should not be shown, as e.g. *"Machines do not need our care"* (183). Or *"Taking care of machines is a fallacy, an omniscience that alludes mental patiency to them. They are tools. Doing otherwise results to long-term damage"* (12).

The reasons for not showing care for one's self, for machines, for living species and for the environment overlap. We therefore listed and explained reasons for not showing care, referring to the different ways of caring in the explanations of reasons, rather than describing reasons for not showing each of the different ways of caring.

5.2.1 They had not thought about it until doing the survey. One example illustrating this reason is: *"Just not on my radar, unfortunately. But this survey has made me think about this!"* (49). The respondents had not thought about care until they took the survey, which in this case made the respondent consider the issue. One of the respondents stated that *"it's easy to forget about environmental sustainability in CS, despite these being topics that I'm very passionate about personally"* (135). We found this reason in a few answers explaining why the respondents did not share care for themselves, other species, and the environment.

5.2.2 Irrelevant, or does not naturally come up. Respondents described the reason for not taking care of living species (for self, other humans and species, and the planet) as being that it is not part of the course content. It is out of scope, there is no space, no time, no opportunity, or no occasion. For well-being, we found e.g., *"outside of a pastoral setting, opportunities don't seem to arise to address wellbeing issues."* (36), or *"it has never arisen as a substantive issue during teaching / interaction"* (40). Another example of not showing care for living species and the planet is: *"Taking care of other living species or the planet seems like out of scope for my teaching."* (37), or *"It's hard to connect it to the material often, and I don't want to go off-topic too much when we have limited time in class"* (44).

Respondents did not always specify the courses or content that do not lend themselves to teaching about care for living species. Several times they referred to computing courses in general. The courses they did bring up are CS2 (62), which according to the respondent, *"focuses so much on technical aspects of programming and programming skills"*, computational logic and computational physics (84), educational data mining and learning analytics (128), and computing systems (109). Two of the respondents argued that the discipline or course is too dense and therefore it does not lend itself to discussing environmental impact. One of the respondents argued *"the course is information dense and technically challenging, so there is very little room for discussions outside the subject matter (this is not an ethics course, after all)"* (6).

Showing care for living species was also perceived to be irrelevant when being a supervisor in computer labs. Another respondent said it is not their role *"to discuss climate change and other non-computing issues"* (173). The respondent's view that climate

change is a non-computing issue also relates to the *"I cannot or do not want to"* theme, discussed below.

5.2.3 Care is personal, private and not professional. The respondents argued that care for living species is not shown because this is a personal or private concern, and should not be part of their professional work. An example of not showing care for oneself is *"my personal 'well-being' is not something I think about sharing in the classroom"* (67). Furthermore, we found *"Taking care of other species and planet is personal preference and it's not nice to get into other's personal space without an invitation"* (86).

5.2.4 "I cannot or do not want to". The respondents explained that they did not model care (all ways of caring mentioned except care for machines) because they lacked knowledge, or because they did not value it, or because they did not have what is perceived to be needed to show care. We found a lack of knowledge about taking care of humans, other species, and the planet. One of the respondents felt *"ill-equipped to engage in those discussions [on endangered species] and rarely has an expert in the topic to lead the discussion"* (198). In terms of value, we found the statement *"My well-being is of low priority for me so there is not much to show"* (139). In terms of care for other species and the planet, we found *"I don't want to take care of plants or animals"* (184) or that the respondent *"does not embody it"* (66), or *"I do not have plants or animals in my office / campus buildings"* (5).

5.2.5 The students. Some of the respondents saw reasons for not modeling care in the students. For example, students were found to object to caring for the planet, *"Environmentalism doesn't sit well with some of my students"* (114). In terms of care for machines, the students were seen to *"know it already"*. Also, for environmental issues, students were seen to be more knowledgeable or sensitive due to their pre-university education.

5.3 Emotions

Many respondents chose to elaborate on the reasons and the situations in which they showed/did not show emotions. Therefore, our themes were: emotion(s) one shows, the reason why one shows emotion(s), the situation in which one shows emotion(s), as well as emotion(s) one does not show, the reason why one does not show emotion(s), and the situation in which one does not show emotion(s).

In general, the respondents were more willing to elaborate on showing emotions than not showing emotions (Table 5). The most often elaborated emotions in the open-ended question were enjoyment, frustration, and confusion. Most responses were short accounts (1-3 sentences) on reasons for showing or not showing emotions, and situations in which emotions were shown, or not. Some respondents also elaborated on emotions not listed in the closed-ended question, but we left those responses out of this analysis.

The emotions that educators elaborated on were related to various situations and experiences from challenging problem-solving situations and technology that does not work, to times when students succeeded. Educators also reflected on emotions more generally in relation to teaching, computing as a field, and the role of computing in society.

In this section, we have reported on the results emotion by emotion, starting with frustration as it was the most elaborated emotion of all. We then continued on to enjoyment, confusion, pride, hope, and fulfillment.

5.3.1 Frustration. We found several situations in which frustration was shown. Skills practice and development situations included problem-solving, live coding and demo, and debugging. Not knowing the course material, technical details, computing topics, or how to use certain tools represented situations described by many participants. The educator's role and the programmer's identity also framed opportunities by which participants were willing to share their feelings of frustration. Within the context theme, technology-related situations were often mentioned. One participant stressed that *"it's useful for students to understand that even experts get confused and frustrated by tech"* (60). Another context-related situation represents the *"limitations in the organisation"* (74) or *"stupid"* management decisions: *"I unveil that and show that I'm not satisfied with the ways things are"* (153).

The analysis of the reasons participants gave for showing frustration revealed that this emotion is *"normal and ok"* (58), *"likely to happen"* (164), and *"an honest reaction"* to situations when things do not work. One participant observed that *"it's important to normalize struggle"* (167) to support students when they feel overwhelmed or frustrated. Often the rationality for showing frustration was associated with practicing and developing debugging and problem-solving competencies. Thus, by showing frustration, some participants thought of opportunities *"to teach [students] a systematic approach to debugging in a way I think they appreciate"* or *"help them understand that they can learn a lot of very useful skills by learning to troubleshoot problems"* (164). Perseverance was another example of competency development that justified the expression of and coping with frustration: *"I also demonstrate how things can get frustrating and difficult at times in order to show them my persevering"* (52).

Other reasons included the acquisition of content knowledge, *"encountering new areas of knowledge or thoughts"* (110), and workplace-related challenges one *"needs to navigate and act [upon ...] to get things as good as possible for the students"* (74). One participant pointed to the data scientist's professional identity, the development of which requires that frustrating steps in the process of *"learning how to read documentation"* (2) be overcome. Within the identity theme, some participants elaborated that *"being oneself"* (117) and *"as open and honest as I can"* (146) can help students realize that *"teachers [a]re people too"* (135). Related to identity and context, one participant emphasized the benefit of showing frustration to expose *"negative sides"* in computing *"like high stress and mental health issues"* (146).

A common theme derived from analyzing reasons for not showing frustration captures many participants' belief that a productive, positivist learning environment should suppress frustrations. Showing frustration was perceived as *"not be[ing] constructive"* (139), *"rarely leads to positive outcomes"* (92), *"it's negative for their learning"* (123), and *"obstructs the learning situation"* (156). A related theme includes student motivation, confidence, patience, well-being, and hope. With students in mind, participants noted that frustration *"drives down motivation"* (12), *"diminish their hope for work"* (172), *"not helpful to their overall mood"* (12), *"would discourage students*

from engaging in the course of office hours" (115). Educators' factors of preparation, health and personal exposure were also brought up as reasons for not showing frustration.

An interesting finding is how controversial participants' reflections on the frustration emotion were. Not only did participants have diametrically opposite reasons for showing versus not showing frustrations, but the same participants expressed conflicting views in their consideration of frustration. One participant recognized that showing frustration impedes students' confidence in the educator's expertise, but it is also *"important to convey that it's normal"* (28).

5.3.2 Enjoyment. Educators described several situations and contexts in which they showed enjoyment. Many situations related directly to students and their actions, such as when students contribute to a class or succeed in their tasks. Other situations related to specific phases or processes when programming, like finding the causes of an error or getting the program to run correctly. Educators also showed enjoyment when they got to talk about topics that interested them, their research, or interesting research more generally. The data suggested that there were several reasons and situations in which enjoyment was shown even though the display was not necessarily done on purpose.

Educators showed enjoyment because they enjoyed teaching and mentoring. On the other hand, not liking teaching was also a reason for not showing enjoyment. Other reasons for showing enjoyment related to the aim of creating a better learning environment and a pleasant atmosphere. Educators showed their enjoyment in the hope that it would make the course enjoyable for the students, it motivates students and creates *"enthusiasm for what they are doing"* (104) either in a context of a course or referring to a wider context: *"Students ought to enjoy their chosen career"* (112).

5.3.3 Confusion. The analysis of the situations in which participants show, or not show confusion, revealed that confusion is often shown when doing live coding, demonstrations, answering questions, or being in the lab. However, one participant mentioned that they explicitly did not show confusion when answering questions from students since *"the confusion could be perceived as criticism of the student"* (100). There were also many descriptions about showing confusion due to a lack of content knowledge or making mistakes in coding.

When describing reasons for showing confusion, the participants mentioned that they wanted to normalize failure and show that computing educators get things wrong, too, such as in this quote: *"I show confusion when modelling problem solving to help normalize struggle."* (180) Another reason for showing confusion was related to learning, and creating a learning environment where the confusion is a natural part of the learning process, and the problem-solving process. Many also stressed that they wanted to show how to overcome confusion and find a solution, as in this quote: *"I do try to discuss points of confusion and explain why I'm confused and what I'm doing to figure things out"* (19). Interestingly, some used the same learning environment reasons for not showing confusion, as they perceived that showing confusion *"most of the times, that would not be constructive"* (41), and *"not helpful for the students"* (150), and *"I strive to never show confusion to students because it can impair the effectiveness of the student experience."* (42)

Some of the computing educators wanted to show confusion to make the students less stressed, and to help them relax: *"in my experience, it helps them relax too"* (12). Interestingly enough, some computing educators saw confusion as having the opposite effect on students, and they didn't want to overwhelm the students: *"I don't want to overwhelm students with confused emotions."* (95).

A common reason for computing educators not to show confusion was that they did not want to seem unprepared and that showing confusion in teaching means being ill-prepared, as in this quote: *"A properly prepared lecture should minimize confusion"* (198). Some computing educators stressed that they wanted students to think they have prepared well, and therefore they do not show confusion.

5.3.4 Pride. Some educators described the situations in which they felt pride. However, the situations often overlapped with the reasons for showing pride and therefore we have described them here together.

Many of the computing educators stressed that they wanted students to be proud of their work (the product) and felt proud of the models or software they have produced, as in this quote: *"I want the students to be proud of their work, when they've made the effort, so I'm often very positive in my comments."* (73) and *"I show pride and excitement when students develop good code"* (56). Other computing educators expressed that they want students to feel that they are proud of themselves or their behavior, as in or *"attempt a new problem on their own"* (85). There were also a few who mentioned showing pride in the profession (21), and that students do things that matter to the world (122).

There were also some computing educators that explicitly avoided showing pride, and had strong feelings related to this emotion: *"I intensely dislike pride in all forms in everyone, including me. I try to avoid it for myself and would be very embarrassed to display it"* (27). The reasons were that in their experiences that they did not feel pride: *"I said never for pride because that's just not an emotion I have around computing."* (61). Many also saw pride as the opposite of being humble, and therefore explicitly did not show pride: *"I am always humble so teaching someone doesn't give me the opportunity to be [sic] pride"* (99).

5.3.5 Hope. The situations where hope is shown related to teaching and supervising situations. Especially projects and tasks that prompted discussion on the evolving technology and what might be achieved in the future were mentioned by the respondents. *"I interpret showing 'hope' merely as highlighting to students how technical solutions and knowledge might be improved in the future."* (188). In addition, the accounts on hope also discussed situations in which projects were done to contribute to *"current needs"* (160) or to large challenges the whole world is facing. *"I teach a module on how technology projects may help with sustainable development goals, and how as technologists, we may be part of a solution. There is a lot of hope and enthusiasm, and pride in what we achieve in our discussions."* (131). Educators also explicitly talked about the role of computing in society. *"We talk often about the role of computing in society and my hope for them to do powerful things for the greater good with their skills is often expressed"* (45)

The educators' answers suggest there are three main reasons for showing hope. First, educators showed hope to motivate and excite

students. *"I have shown hope and enjoyment to excite my students and to them a reason to come back to class in huge numbers"* (133). Another reasons to show hope was to help students to feel more confident in the task they are doing, whether it is a smaller task at a course or a larger project such as a thesis. *"All of my thesis/dissertation students have had at least one point in their programs at which they doubted that they would successfully complete their research. When discussing their concerns, I have always been able to show my understanding of their situations by relating them to my past experiences as a student and advisor. I am then able to express my confidence ('hope') that by working together, we will be able to overcome the challenges and obtain a successful outcome."* (92).

We found two reasons for not showing hope in a class. One respondent said that they did not know how to show hope in a class. The other reason related to educators' experience that they did not associate hope with teaching computing or that they felt there was not much hope *"I don't show hope often since I don't have much."* (153).

5.3.6 Fulfillment. Respondents often discussed fulfillment together with enjoyment and/or pride as the reasons and situations in which these emotions were shown to be similar. The situations in which fulfillment was shown relate to moments of success. For instance, when *"their program compiles, runs correctly, and shows no memory leaks . . . "* (31) or students understand a difficult idea. *"Fulfillment manifests as triumph when a student understands a difficult or complex idea, particularly when an idea 'clicks'; I encourage them to celebrate this as a specific learning moment."* (145). Some respondents gave specific examples of teaching situations in which students' learning prompted the educator to show enjoyment and fulfillment . *"...I love teaching recursion and am usually pretty successful at that. It makes me go apeshit when students get it and I nearly whoop for joy."* (27)

One often mentioned that the reason for showing fulfillment was to motivate students and *"show that it is normal to derive pride and enjoyment for creating software"* (37) or to show *"how computing can be a very fulfilling profession that one can be proud of."* (21).

There were two reasons for not showing fulfillment. Either the educator was *"not sure how this emotion would occur in my courses."* (48). Or they did not feel fulfillment due to drastically expanded workload. *"I hardly ever feel fulfillment. Over the last few years, I have become a conveyor belt. The student numbers have quadrupled. This is because the university administration sees online learning (which came about due to Covid) as a chance to register significantly more students than before and thus attract significantly more subsidy from the government. Nowadays, there is very little education and therefore very little fulfillment."* (35)

5.4 Professional competencies and other kinds of role modeling

The participants answered a question in the survey related to showing other kinds of role modeling: Q7. *What other parts of you (behavior, competence, ways of being, achievements) do you wish that your students see in you and imitate?* We also looked at answers to the questions Q8 and Q9, in which the participants could write anything else they would like us to know, and their email address for future work if they wished. A few participants used the latter

to make further comments, and these are analyzed here as well. As opposed to the few or more sentences written as responses to the questions on care and emotions, some of the responses to Q7 (and to Q8 and Q9, if present) simply listed aspects of role modeling using one word, rather than writing a more detailed explanation. For example, for Q7 *"Correctness, politeness, the joy of programming and exploring."* (156), while other quotes, as shown below, included more context. These differences in context are acknowledged in our analysis.

Professional competencies were categorized according to [53]. The kinds of role modeling that did not directly fit this framework were thematically analyzed as two themes: 1) Identity (social and disciplinary), and 2) Outside of learning environment. While most of the data allowed us to address RQ1 (what is -not- modeled), we were able to include some analysis addressing RQ2 (context of -not-modeling) and RQ3 (reasons for -not- modeling).

5.4.1 Professional competencies. Participants referred to professional competencies in various ways when answering questions Q7-Q9. We use definitions from the 2021 ITiCSE Working Group report *Professional Competencies in Computing Education: Pedagogies and Assessment* [53] when identifying themes related to "professional competence". The report divides professional competencies into dispositions and cognitive competencies, the latter being about knowledge and skills. The dispositions are grouped into *intrapersonal dispositions* and *interpersonal dispositions*, and are mapped to the intrapersonal and interpersonal domains of competence defined in the *Education for Life and Work* report [37]. We used the two groups of dispositions and *cognitive competence* as labels for the sub-themes in our analysis, since they fit well with the answers we obtained from our survey.

Intrapersonal dispositions In the 2021 ITiCSE Working Group report, citing [37, p. 3], intrapersonal dispositions are defined as "the capacity to manage one's behavior and emotions to achieve one's goals (including learning goals)". These dispositions are structured into three clusters as shown in Table 6. In the following we present which of the intrapersonal dispositions described in the literature we found as well as additional dispositions that are not mentioned in the literature.

Cluster	Intrapersonal dispositions
Intellectual openness	Flexibility, adaptability, artistic and cultural appreciation, personal and social responsibility, appreciation for diversity, continuous learning, intellectual interest and curiosity
Work ethic	Initiative and self-direction, personal responsibility, perseverance, productivity, grit, metacognition, self-reflection, professionalism/ethics, integrity, citizenship, career orientation
Core self-evaluation	Self-monitoring, self-evaluation, self-reinforcement, and physical and psychological health

Table 6: Intrapersonal dispositions (from [53, p. 135])

There are mentions of dispositions in the intellectual openness cluster in the answers. The following dispositions listed in Table 6

(from [53, p. 135]) were explicitly mentioned in the answers: flexibility (20, 33, 143), personal and social appreciation for diversity (140), continuous learning (168, 170, 174, 177, 191, 200), intellectual interest/interest (108), curiosity/curious (5, 13, 72, 93, 132, 140, 156, 165, 174, 177, 200).

Other similar dispositions, or aspects, that we found related to the intellectual openness cluster, though not in the list, were: acceptance/accepting (18, 55), creative (72, 156, 161), dealing with opportunity for change (169), enjoying (146), enthusiasm (49, 60, 84, 107, 116) excitement (129), explore options (161), fun discovering (125), growth mindset (48, 93), inclusive practices (27, 62), joy (157), motivation (107, 127), open (147, 160), open-ended-ness (125), open-minded (59), openness (145, 154, 195), passion (78, 104, 136, 186), self-learning (106), and sympathy (37).

Intellectual openness was captured in responses such as *"To always be active in seeking new information. What happens out there might have an effect on what you should choose to focus on for your personal development."* (74), *"I would like students to see that I am open-minded and interested in learning about what other academic disciplines can teach us about computing."* (59), *"open to requests and different ideas"* (24) and *"openness to evidence"* (40).

There were also mentions of dispositions that fall into the work ethics cluster. The cluster work ethic (3) itself was also mentioned. The dispositions explicitly mentioned in the list were initiative and self-direction (174, 56), perseverance (32, 49, 61, 165), grit (111, 169, 180, 200), self-reflection (97), persistence (12, 17, 20, 25), professionalism (24, 36, 144, 168, 181), ethics (17, 93, 144), and integrity (22 134, 201). Other examples of mentions of work ethics would be *"Fun making something work that's valuable for others"* (125) and *"I would also like students to see that solidarity with other university workers is important to me."* (59).

Similar dispositions that we found related to the work ethics cluster, though not in the list were: being serious (122), caring (160), conscientiousness (190), determination (47), diligence (167, 190), goal-oriented (180), honesty (11, 22, 73, 78, 101, 104, 147, 160, 190), intellectual honesty (14), patient (21, 37, 186), prepared (46, 110), punctual (191), social responsibility (176), stubbornness (136), value learning (5), and work hard (46, 53, 92, 100, 146, 168).

Examples that can be seen as being variants of self-reflection are *"admitting I don't know is ok/ok to not know"* (92, 105), and *"ok to make mistakes"* (123). An aspect of professionalism is *"understanding wider consequences of technical solutions"* (176). Also related to professionalism and citizenship is *"Professional and personal life guided by ethics (in particular, concern for humanity, environment, etc.)"* (93).

None of the dispositions in the core self-evaluation cluster were explicitly found, although these were identified as responses to other questions in the survey (see care in 5.1.1). However, similar dispositions related to the core self-evaluation cluster, though not in the list, were: self-compassion (15), self-care (65), confidence (122, 127), secure in oneself (124), *"know what you know and what you don't know"* (124), *"not afraid of failing"* (132), *"unafraid of being wrong"* (145). An interesting variant of self-evaluation is *"Aware of importance of luck and support"* (53).

Interpersonal dispositions The ITiCSE 2021 Working Group report [53] maps interpersonal dispositions to the interpersonal domain of competence in [37] and, citing [37, p. 3], defines interpersonal dispositions as "expressing ideas and interpreting and responding to messages from others". These dispositions are structured into two clusters as shown in Table 7 (from [53, p. 136]).

Cluster	Interpersonal dispositions
Teamwork and collaboration	Communication, collaboration, teamwork, cooperation, coordination, empathy, perspective taking, trust, conflict resolution, negotiation, service orientation
Leadership	Leadership responsibility, assertive communication, self-presentation, persuasion, and social influence with others

Table 7: Interpersonal dispositions (from [53, p. 136])

The dispositions in the teamwork and collaboration cluster explicitly mentioned were: communication (125, 147), collaboration (40, 55, 93, 170, 195), teamwork (93), cooperation (20), empathy (20, 30, 33, 145, 187), and trust (104, 172).

Similar dispositions that we found related to teamwork and collaboration, though not in the list were: accepting (166), ask questions (165), being approachable (6), behave well to others (180), care (95), care for others (18, 95, 181), caring (21, 160, 172), compassion (172), commitment (119), concern for others (117), engage in discussions (154), enthusiasm (60, 84), fairness (48, 55, 140), having manners (177), helpful (166), humbleness (88, 100, 131), humility (20, 53), inclusive practices (48, 55, 62), kindness (20, 41, 88, 143), listening (100, 160, 199), multidisciplinary collaboration skills (55), patient (166), politeness (157), reassuring (159), respect (41, 181, 199), share innovative ideas (122), supportive (146, 147), sympatic (143), and welcoming (160). Some of these dispositions correspond to the findings in care (see subsection 5.1.1).

Other examples clearly related to the teamwork and collaboration cluster are *"always being prepared to help"* (33) and *"ask other professionals for help"* (46).

Only one of the dispositions in the leadership cluster is explicitly mentioned: the leadership responsibility (179, 200), and an aspect of leadership responsibility is *"Clear about what's done (and who's done it)"* (101). However, social skills (4) and handling frustration (32) can be seen as variants of social influence with others.

Not in the list, but dispositions similar to the leadership cluster, are: confidence in their skills (62), deal with fallibility (131), fairness/inclusive practices in leadership (48, 55, 62), inspire hope (179), promote change (173, 179), and tolerant (140).

Cognitive competence In this sub-theme, we decided to group together answers related to knowledge and/or skills related to technical aspects of computing. A very specific answer mentioned using Git: *"Confidence in dealing with new situations and finding a path through the ambiguity via small experiments and backing up your work via Git"* (126). There were some participants that referred to ways of solving problems and using systematic thinking.

Professional competence is also about cognitive competence (content knowledge and skill-based competencies) and there were

some answers that fell under this theme. There is a mention of *"knowledge (breadth and depth) of CS concepts"* (96). Skill-based competencies are explicitly referred to as problem solving using stepwise refinement: *"divide the problems into something I can solve"* (11) and attention to detail when writing code (13, 167) with particular emphasis on *"courtesy programming (easily readable, adaptable, and extensible code)"* (35). The notion of computing as a discipline that requires critical thinking and *"thinking outside (technical) norms"* (13) is emphasized also as *"Computing disciplines are problem solving disciplines. The problems to be solved can be underconstrained or under-specified. The specification may be ambiguous. The solution strategy may be uncertain at first"* (53).

Some participants mentioned showing technical competence in general such as: attention to detail (3, 14), problem solving (12, 42, 54, 55, 61, 68, 78, 123), systematic thinking (20), technical competence (22), being well prepared (33), rigorousness in reasoning (34), resourceful (36), competence/competence in CS (37, 56), good record-keeping (40), learning from slips and errors (40), user focus (44), planning (45, 65), and time management (45). Critical thinking (6, 14, 62) also appeared and a variant was stated as being critical of systems and languages, critical of "improper" approaches to computing (28), critical reflection (40), and diligence (91), and clarity (91) and knowledge (91, 97) and get to bottom of things (97), not reinvent the wheel (101), work structured (111), scientific (140), attention to detail (154), correctness (157), strive for simplicity (161), troubleshoot (165), competence (167), know the subject (180), and focus on what's important (185).

Taking into account emotions in an interesting manner, this respondent elaborated aspects related to cognitive competence: *"I would like to them see and imitate the attention to detail, thoroughness when explaining/writing down the workings of some solution to a problem, to see how I deal with confusion when something doesn't make sense and trying to understand why without being embarrassed."* (66). Similarly, placing the problem solving competence in an emotion context: *"I do live coding and problem solving when teaching and try to let students know my thought process as I do so .. as any decent educator would."* (68).

5.4.2 Identity. Participants referred to their professional identities, such as being an academic, and social identities, such as being a woman. Many answers implied a disciplinary identity, but it was rarely explicitly stated. How these identities are displayed and perceived is dependent on context and different reasons.

Being outside of the norm is a situation highlighted from various perspectives. An educator that *"found computing in a somewhat non-traditional path"* wants *"students to realize that there is no 'single path to success' in computing"* (1). Awareness of context was shown by educators that mentioned how being in a discipline as male-dominated as computing led to that educator representing competence outside of this norm: *"I hope that, via my example, students see that females and extroverts can be competent professionals in our industry"* (37), or the intersection with other aspects, such as age: *"I hope to demonstrate that my field is not only for men in their twenties."* (150). It was hoped that exposure to educators from underrepresented groups would contribute to students examining their own biases: *"I wish that they [the students] see that not only white cishet men can do this and apply that knowledge to alter their*

(internalised) prejudice." (15). This exposure is presented as limited in terms of e.g., gender: *"I try to help them see that women can be confident in their use of technology. I may be the only female professor some of these students have in computing. I [want] to discourage them from developing (more) sexism."* (114). And the intersection with age: *"As a woman […] I also hope that as someone who is older and still very innovative I can be an exemplar of why one should not be ageist."* (173). This potential effect on biases is not limited to a particular student demographic, e.g. *"And being a competent woman with many achievements is good for males and females to see."* (31). Another approach to exposing students to role models from underrepresented groups is through giving visibility to professionals other than the educator themselves (57).

Success in getting grants and awards (192) or official acknowledgments of success by managers (99) are some of the concrete achievements shared with the students. Industry experience is presented as an advantage: *"Too few teachers actually have experience of working as an engineer or with engineers, outside the academia. I can give examples that few other teachers can."* (74). If this experience is not recent, obstacles are perceived: *"Though, I often see them [the students] focus on the latest fads or populist intellectual properties, informed by early career researchers who have recently joined the department from industry."* (42)

Academic experience is also highlighted, e.g. *"With 40 years of work experience, I have a lot of stories that I tell the students. […]. Since some of the stories are about my failures and others about my successes, students see (I hope) that there will be ups and downs in their careers."* (141). This intention to represent being an academic as more than the success that the students may perceive was described in terms of support and luck (such as *"I regularly tell my students that I'm no better/smarter than them, I just have more experience, and that my being at the front of the room has as much to do with luck and support I received from others as it does with my own hard work"* (52)) and academic obligations outside of the classroom: *"My struggling with the workload (students do not often think about that professors do much more work than teaching)."* (62). Role modeling as an academic for students is seen as an important consideration in more contexts, *"beyond the focus on the impact of PhD supervisors on their PhD candidates."* (110).

There were some respondents who did not see themselves as a role model. This can be because a) educators think they lack competence (7); b) they should not be the focus: *"I do not wish them to focus on me and have any opinions - apart from believing that I know what I am talking about and wish them well."* (151); c) the role model effect varies among students (*"I never think of myself as a role model either. Maybe I am for some, probably not for most."* (27)); or because d) context prevents educators from succeeding in their role modeling: *"However, working in a society that shares few of my ideals in theory and almost none in practice makes [showing students how to pragmatically and responsibly work within technological trends] a balancing act."* (13). The latter is also related to the teaching hierarchy and in particular teaching assistants (TAs) having less or no control over what is taught (7), or how students may perceive them: *"Often me and my fellow TAs are very humble to the students and sometimes students can take it for granted and start to perceive it in a way that allows them to think they are above us and that talking to us can seem like a waste of time."* (87).

5.4.3 Outside the learning environment. Here we focus on context, and how it can expand outside the teaching and sometimes even professional context. Examples of such answers on professional competencies are honesty, integrity, empathy, curiosity, humility, helpfulness, listening, and patience, which are listed above. These are sometimes listed as one word without context, e.g. *"curiosity"* (12). Other times the context is explicitly broader, with educators wanting their students to see: *"My research, who I am, and what I do outside of classrooms"* (50), that they are academics and not exclusively educators: *"struggling with the workload (students do not often think about that professors do much more work than teaching)."* (62), showing what that means outside of the teaching setting. Hopefully, the educator being perceived *"[. . .] as a complete person - both invested in my professional life and having a life outside work."* (173), which was in line with answers on care and showing parenting responsibilities. More specific answers included *"Taking care of your personal finances."* (35), which seems outside of the formal learning environment.

Examples on what to avoid were also given for the broad context, such as modeling bad decision-making in both professional and personal life (7). Aspects were mentioned that depend on the values of the educator and could potentially be interpreted as negative by an observer from the perspective of the educator, such as *"Showing respect for yourself in the way that you dress, e.g., it is possible to dress in a modest way while still looking modern and 'cool'."* (35) or *"Trying to improve your lot in life instead of staying in 'victimhood'."* (35).

6 DISCUSSION

In this research project, we aimed to improve our understanding of how care, emotions and related professional competencies are shown by computing educators, reasons for doing so or avoiding these displays, contexts for these and other aspects of themselves that computing educators think they show or do not show. Below, we integrate the various parts of our findings, especially the quantitative and qualitative results, and we have discussed the findings in relation to previous research. We conclude with the contributions of this work, implications for teaching, and future work.

Table 8 summarizes the extent to which care and emotions are shown in teaching settings and reflected upon, as well as the dependency with teaching experience. Further, our findings provide insights into how care and emotions are shown, i.e. elaborations on what different types of emotions and care are expressed, situations or contexts, as well as teaching situations in which they are shown or not shown. Further ways of being that are reflected upon are described in terms of professional competencies (intrapersonal, interpersonal, and cognitive competencies), social and disciplinary identities, and contexts outside of the exclusively professional activity in which they manifest.

6.1 Showing engagement beyond the technical, rational and theoretical in computing education

Prompted by references to three main constructs (care, emotions and professional competencies), the survey respondents described their approaches to showing ways of being in computing and situations or teaching contexts that go beyond the technical, rational,

and theoretical. This suggests that such ways of being in computing are not absent. We have also described reasons reported by the respondents for not showing certain ways of being in computing. Some respondents reported showing care, emotions, competencies, and other ways of being as part of their job, while others were hesitant or strongly argued against it. In the following, we have discussed what we found on role modeling, care, emotions and professional competencies in relation to the existing literature, to understand computing beyond what previous research describes as the norm.

We categorized our findings in terms of *types of role modeling* using Grande's role modeling framework [15]. Considering positive role modeling as an example to follow and negative role modeling as an example to avoid becoming, we found examples of both. Educators described expressions of care and emotions, displays of professional competencies, and other aspects and achievements that students would benefit from imitating. Conversely, when context and/or perceived lack of competence hindered the educator, this type of role modeling was to be considered as negative. *Intention* of role modeling was focused on the so-called positive interpretation, while negative role modeling was mostly unintentional. The focus on *awareness* of role modeling in this work can be refined by the consideration of time: awareness that the participant brought with themselves, complemented in some cases by new awareness of their other kinds of role modeling prompted by the survey questions. In the following paragraphs we have described these types of role modeling by their connection to one or more of the constructs in this paper: care, emotions, and professional competencies.

We found that *care* is part of what computing educators role model. This challenges previous research to some extent (see Sections 2.1 and 2.2.2). We found a dominance of care for humans (oneself and other people) as opposed to care for technology, other living species, or the planet. Caring for other humans as an educator is in line with Mariskind's application of phases of care to higher education teaching [33], in which educators identify and aim to meet the needs of their students. Mentions of frustration with academia, systemic barriers, etc., as expanded below, can be interpreted as the educator being a care advocate for colleagues and/or students (see 2.2.2). Educators caring for themselves in terms of well-being practices fits current research on wellness perceptions and their connection to thriving in engineering academia [64].

The fact that care for people was dominant in the responses can be seen as anthropocentric care, focusing on human beings as the most important entity. This focus mirrors the challenges of our epoch, the Anthropocene, in which humans are the dominating and changing force in the global ecosystem [26]. Our findings also support previous literature criticizing the separation of technology and nature or the environment (see e.g. [1]). Yet, we did find examples of educators who were actively trying to show care for other than humans and who also saw this as important.

Research suggests that computing centers around technology, so care about technology should be natural. However, care involves emotions and relationships, and several respondents seemed to dislike the idea of care for technology. Others, on the other hand, seemed more open to understanding their engagement as care for technology. We suggest that re-interpreting engagement in computing as care for technology could help to broaden participation

	Care	Emotions
Extent to which shown	Respondents showed care of self (well-being) and care of other humans more often than other types of care (technology, other living, planet). Respondents showed least often Caring for other living species the planet (compared to other types of care).	Respondents showed more often enjoyment and fulfillment. Respondents showed confusion and frustration least often.
Dependency with teaching experience	Teaching experience is connected with how often care is shown. Educators with longer teaching experience showed General Care and Caring for Planet more often than those with shorter experience.	The amount of teaching experience does not seem to be connected to how often educators show emotions.
Extent to which respondents reflect showing, not showing	Respondents elaborated more on showing care for self and other humans and less so on not showing care for self and other humans. They provided many more reflections on why they do not show care for technology, other living species and the planet than reflections on how they do show care for technology, other living species and the planet.	Respondents elaborated much more on reasons and situations for showing emotions than for not showing emotions. Frustration was elaborated most even though it was the least shown emotion. Especially, educators elaborated on reasons for showing and not showing frustration.
Reasons for (not) showing	We found several reasons for not showing care: Educators had not thought about this before doing the survey, showing care is irrelevant or is not part of the course content, care is personal and private, educator does not know how to show care, and students know it already (concerning environmental issues) or object the idea (caring for planet).	Reasons for showing emotions included four larger themes: educators themselves (enjoy teaching, want to be themselves when teaching), students and students' learning (helps to get motivated, normalizes emotions such as frustration), creates good learning environment, helps students to learn important competencies (e.g. perseverance). Reasons for not showing related to experiences with teaching (not liking teaching, does not feel e.g., fulfillment when teaching), educator thinks showing emotions is not productive for student learning, and computing as a field (does not feel pride when around computing). Sometimes there were opposite and conflicting reasons for (not)showing emotions (particularly frustration).

Table 8: Summary of some of the qualitative and quantitative findings on care and emotions

beyond the technical and make computing more accessible for marginalized groups.

Rendering computing an endeavor beyond the rational, our findings suggest that educators show *emotions*. This is well in line with previous research on the emotions of higher education educators: in terms of showing emotions, educators are more inclined to show positive than negative emotions in teaching situations, but in terms of talking about emotions in teaching, educators are inclined to share their thoughts on showing negative emotions more than positive emotions [19]. We also found that the length of teaching experience was not related to the willingness to show emotions. This suggests that there are other factors that may explain the differences in showcasing emotions in teaching or mentoring situations. Some of these factors may be cultural, according to previous studies (e.g., [19]) that compared higher education educators from different

countries, suggesting that cultural factors may play a major role in varying degrees and ways of showcasing emotions.

Many of the reflections on frustration and confusion were directed to technology, in line with previous research (see Section 2). For example, the respondents mentioned frustration and confusion about non-functioning programs or non-executable code. There were few mentions in which educators showed their frustration on something other than technology-related issues as well, e.g., the state of academia. The reflections on showing enjoyment, fulfillment, and pride were often related to well-working code but also to success moments, such as, when students understand difficult ideas or a notion that the respondent likes teaching or is good at teaching a certain topic. There is no mention of educators showing frustration about the state of the world, and challenges such as climate change, mass extinction or growing inequalities and limited action

to address these challenges. However, some educators explicitly conveyed hope for what evolving technology can achieve in the future, what the role of computing is in society and that students can use their skills for the greater good.

Some of the educators argued strongly against showing emotions and care. For some respondents, care and emotions do not have a place in computing education, which shows how the idea of care and emotions in computing education can evoke rejection and resistance. This, in turn, can contribute to marginalizing care and emotions, e.g. if others see those aspects being questioned [17]. Restricting showing emotions in teaching situations may however have unwanted consequences. Toraby and Modarresi's study [75], for instance, showed that the enjoyment that educators display was the best predictor of students' views on educators' pedagogical success. In addition, educators' displays of pride and enjoyment were good ways to motivate the students.

The resistance to showing emotions and care was not visible when respondents described showing, or not showing, *professional competencies*. Perhaps influenced by the order of the survey questions, with care and emotions presented before competencies, respondents often referred to showing emotions and care as a part of showing (professional) competencies. The care aspect in particular might be related to discussions about the need to educate a new type of engineer, one that is better equipped to contribute in dealing with the grand challenges of today´s society.

There are several similar descriptions of professional competencies. We used a previous ITiCSE working group report [53] as a typical example of such descriptions. We could identify a majority of the explicitly mentioned dispositions in the intrapersonal and interpersonal disposition clusters. The respondents also gave many examples of similar dispositions, such as dealing with opportunities for change, excitement, honesty, diligence, unafraid of being wrong, and social responsibility, to mention a few. Emotions and care are often an aspect of these dispositions.

We also identified cognitive competencies, although these were less prominent. That is somewhat surprising, since the cognitive competencies are more strongly associated with how the computing subject is viewed. This may connect again with how the questions in the survey may have led respondents to reflect on personal aspects rather than more objective aspects.

Competence, the perception of it being a key factor for effective role modeling [14], was connected to *identity* by the participants in two ways. Some referred to a norm in computing education in which white middle-aged men are perceived as (more) competent, highlighting the importance of exposing students to educators who represent one or more social identities outside of this norm, e.g., being a woman. This is in line with research on the effect that role models have on motivation for students of marginalized identities [14].

The second main mention of identity was that of being a professional in academia or (previously) in industry. Length of employment and the use of examples from this professional experience may contribute to being perceived as competent (and thus a role model) [14].

Previous work also raised the importance of *viewing role modeling in the social context*. We raise awareness of the question of who can show emotions and care. The various reasons for role modeling

were based on the perspectives affected by the identities of the educators. For example, "bragging" or showing certain emotions like pride or frustration depends on what is seen as acceptable in certain cultures or by people from a particular gender. As shown in Section 2, care is associated with femininity, while computing culture is found to be masculine. By showing care and more feminine ways of doing computing, educators might risk losing status and recognition [17, 47, 48]). For those who are already at the lower levels of academic hierarchy, such as teaching assistants, this may even be more salient.

We are living in times of *climate crisis, mass extinction and increasing inequalities* [73, 83]. These times should naturally evoke certain types of care and emotions or competencies that we cannot see in our data. Based on our results, computing educators do not seem to be very engaged in discussing aspects of our civilization, factors of societal collapse, or the extinction of species in their teaching, or at least they did not choose to share examples for reasons and situations relating to these topics. As also found as one of the reasons for not showing care (Section 5.2), educators may not know how to make the connection between what they are teaching and the global and social crisis [51]. Our study does not allow us to say more about the educators' awareness and how they engage with the global crisis in their classrooms.

Research suggests that young people today are very concerned about the state of the world [41]. A recent study on emotions in computing also showed that computing students can feel anxiety [8]. Students who feel frustration about the state of the world and confusion about their place in the world, may feel alone and miss role models. Engaging with societal questions is likely to evoke troublesome feelings such as anxiety, hopelessness, and grief that need to be addressed [41, 50]. Getting to know that educators also feel anxious or are deeply concerned can help students deal with their own eco-anxieties, according to a review by Pihkala [50].

6.2 Contributions

Our findings contribute to the discussion on *humanization of computing education* and in what ways role modeling by educators may affect students' development as professionals. This research project has raised awareness among computing educators of care, emotions and related professional competencies that educators can display as role models.

We tried to take a constructive approach to challenges (such as gender imbalance and marginalization) that computing education is facing, and we highlight what is already done at the moment, i.e., to what degree care and emotions and other non-technical related aspects of being a computing professional are shown. Our results have brought forward what educators perceive that they are able to model for their students.

This study shows the need for *scaffolded reflection* using a framework for role modeling such as Grande's [15]. Our participants focused mostly on aspects inherent to themselves, not describing their achievements as much. Understanding what educators see as feasible to model for their students, and encouraging their reflections on a diverse set of types of role modeling (achievements, dispositions, skills, etc.) connected to care and emotions, can have a positive impact on students and their careers. An example would

be an educator modeling the achievement of becoming a parent (a form of care), which can positively affect recruiting and retention of (future) academics from demographics such as Latine, where family is an important consideration for career choices [65]. Educators' role modeling of a healthy handling of negative emotions and well-being practices in the specific context of computing education serve as examples for students struggling with their mental health. These struggles, both for educators and students, are receiving increased attention in research [3, 64, 66, 67]. To our knowledge, no other studies on care and emotions have used the theoretical lens of role modeling as described in this paper.

We provided an *application of two frameworks* that allowed for different levels of abstraction to reflect on role modeling. While the role modeling framework provides a high level of abstraction, we showed its application to the particular context of being a computing educator in higher education. Building on this and by using a professional competencies framework such as the work in the ITiCSE 2021 Working Group [53] we provide a way to present dispositions related to care and emotions as competencies that a professional in computing should develop.

This work also provides some suggestions for *pedagogical training*. Intended learning outcomes and content of the educators' pedagogical training units could be reviewed and amended in light of teacher competencies that go beyond pedagogical and pedagogical content knowledge. Topics such as educators as potential role models, the role of emotions in teaching and learning and in what ways care can (or should) be shown, might help broaden educators' perceptions of what it means to be an educator in computing. This type of discussion may also lead to better understandings of what kinds of norms related to the teaching culture in that particular context exist. This suggestion for pedagogical training also applies to that for teaching assistants, especially since they tend to lack pedagogical training [55–57]. Teaching assistants are often novice educators who interact a lot with students and are perceived as more approachable [55, 58, 59]. Thus, TAs may be perceived as role modeling many aspects of what it is like to be a computing professional by students.

Our results show several examples of how and in which situations care and emotions can be shown and what kinds of benefits educators think showing might bring to students. We therefore encourage all computing educators to reflect on their own *practices when teaching, supervising, and mentoring students*; we hope the reader is inspired by the examples provided in this paper. Discussions with fellow educators in the same computing program, department, etc. about the prevailing teaching culture and of the norms constructed within the community and posed to the students might also prompt that teaching community to develop its practices. Through discussions like these the educators may also build competencies to address the concerns and interests that many young people have. For instance, how computing as a field can address societal questions or how students wanting to show care and act upon it may fit in the computing community and profession.

7 FUTURE WORK

We intend to continue this work complementing the existing data set with in-depth interviews of respondents who indicated their interest in doing a follow up with us, in which we will continue to use the frameworks on role modeling [15] and professional competencies [53].

With this study, the demographic information we were able to collect was limited, which also affected the kinds of research questions we were able to ask. Future work could explore views on care and emotions in relation to demographic information, such as gender, ethnicity, class etc. We had also made the conscious choice of avoiding questions that might have triggered more emotionally difficult reflections, e.g., there is no content in the survey about anxiety, anger, etc. We intend to follow up on these aspects in future work.

Many of the answers did not describe role modeling explicitly. Instead, participants described course content or contexts, something they teach or comes up during teaching, and not what they say they do, or show personally, so that students could emulate. We classified those reflections as *implicit role modeling* in this paper, but further studies are needed to understand this phenomenon.

We have self-reported data from computing educators, which means that we have no indication whether the students themselves are aware of the role modeling, are interested in the aspects modeled by the educators, or are inspired to emulate them. Students' point of view would complement our understanding of educators' role modeling.

While our quantitative analysis was simple in nature, future studies might involve the use of established instruments to measure specific constructs related to the care and emotions aspects of our research. Such data would allow for more complex analysis, such as linear regression or structural equation modeling, that would let us explore more relationships between other characteristics of computing educators and their role modeling priorities.

8 CONCLUSION

This paper provides insights into the *what* and *how* and *why* of role modeling in a holistic way, going beyond the technical, theoretical, and rational norms that have been described as dominant in computing. To achieve that, we built on frameworks of role modeling, care, emotions, and professional competencies as means to unveiling different ways to engage in computing. This work was driven by a goal to make computing accessible and engaging for more diverse people, and also to strongly connect computing to human factors and the human activity of seeking meaning and relevance.

Our work encompasses not only what may or may not be self-perceived as role modeled but in what contexts and for what reasons. Thus, we are not only encouraging reflections on role modeling by individual educators, but also calling for a more systemic approach both to removing barriers and adding scaffolds that supports a more diverse community of role models for a more diverse community of learners in computing.

9 ACKNOWLEDGMENTS

A APPENDIX: THE SURVEY

A.1 Survey information for participants in the research study

Title: Educators in computing as role models for their students
Available: 2022-06-06 − 2022-11-27
Contact person: Mats Daniels, employed at Department of Information Technology at Uppsala University

You have been invited to participate in a research study as someone with teaching duties in a computing-related subject in higher education. In the title of the survey we use the term "educator" aiming to include teachers, instructors, faculty, teaching assistants, lecturers, and many other terms for those involved in teaching.

What is this research study and why do you want me to participate? The purpose of this international survey is to gain a better understanding of computing educators' role modeling. By sharing our results with researchers and other stakeholders in higher education, we aim to contribute to discussions to change departmental culture, develop teaching competencies, and widen the range of disciplinary identities represented through educators in computing.

The entity principally responsible for the research is Uppsala University. This data collection is part of the work done for an ACM ITiCSE Working Group: https://iticse.acm.org/2022/working-groups/

How is the research study set up? The survey is distributed internationally, and participants answer the survey on one occasion. Participation is voluntary. You can cancel your participation at any time without giving any specific explanation. If you want to cancel your participation or have any other questions about the study, please contact the person responsible for the project, Mats Daniels at mats.daniels@it.uu.se

First, we want you to read this information text. If you are interested in participating, then fill in the questionnaire. You consent to participate when you submit the survey.

Participating in the questionnaire study takes about 10-12 minutes. The survey consists of 9 questions that are related to teaching background, role modeling and input on the survey.

Benefits of participating in the study. There are no personal benefits from participation. Your answers will contribute to the aim described in the purpose of the study.

Possible risks with participating in the study. To answer the survey you need to spend around 10-12 minutes with it. The questions are related to your background and your view of role modeling. To think of role modeling might connect to memories that are unpleasant.

What happens to the data collected? The project will collect and register information about you. The information collected is teaching experience, format and professional area, and questions about role modeling as an educator. The information will be collected through a survey. Measures will be taken to prevent the information being linked to you. The reason why the project collects information is to be able to present who participated in the study for research purposes, at group level.

From a team of 10 international researchers, only one of us will have access to the responses. This person will ensure that the data shared with other researchers does not contain personal data, including names, geographical locations, etc. Similar care will be taken for any future publications. All researchers in the team are trained in ethical handling of research data, and we will store the anonymized data following the recommendations in this training.

The legal basis for the processing of personal data, according to Art. 6 of the EU Data Protection Regulation (GDPR) is that the processing takes place to perform a task of general interest, ie. for research purposes. Your answers and your results will be processed so that unauthorized persons cannot take part in them.

Uppsala University is responsible for your personal information. According to the EU Data Protection Regulation, you have the right to access the information about you that is handled in the project free of charge, and if necessary get any errors corrected. You can also request that information about you be deleted and that the processing of your personal data be restricted. However, the right to delete and restrict the processing of personal data does not apply when the data is necessary for the research in question. If you want to take part in the information, please contact Mats Daniels, House 10, Lägerhyddsvägen 1, 752 37 Uppsala, +46 708 918262, mats.daniels@it.uu.se. The Data Protection Officer at Uppsala University can be reached at +4618-471 20 70 and the dataskyddsombud@uu.se. If you are dissatisfied with how your personal data is processed, you have the right to submit a complaint to the Privacy Protection Authority (Integritetsskyddsmyndigheten), which is the supervisory authority.

How do I get information about the result of the project? You will be able to take part of the study results after the study results have been analyzed and compiled. Results from the study will be presented in various scientific contexts, such as the aforementioned ACM ITiCSE 2022 conference, the report connected to it, and research papers and presentations connected to this topic within STEM education communities.

Insurance and compensation. No insurance or compensation is paid.

A.2 Survey questions

Background

We are very interested in learning more about the experiences of educators with all levels of experience in teaching.

Q1 What kind of teaching duties do you have?
- Planning lectures
- Giving lectures, seminars, etc.
- Assisting students in lab sessions, tutorials, or any setting where they can ask for help
- Supervising students with projects (bachelor/master thesis, etc.)
- Other:

Q2 For how long have you had the teaching duties that you answered in Question 1? - Required
- < 1 year
- 1 to 5 years
- 6 to 10 years
- 11 to 15 years
- 16 or more years

Q3 Have you had these teaching duties in computing-related courses? By computing, we mean an umbrella term referring to various sub-disciplines dealing with digital technologies, e.g. computer science, software engineering, or information technology. - Required
- Yes
- No

Q4 In which ways do you interact with your students? - Required
- In-person teaching
- Online/remote teaching
- Supervision meetings, office hours or equivalent
- Learning Management System (Canvas, Blackboard, Moodle, etc.)
- Email
- Messaging services (SMS, WhatsApp, Telegram, Slack, Piazza, Discord, etc.)
- Social media
- Other

Educators as role models

[For all parts of Q5 to Q6 respondents could choose among the options below Q5a) and Q6a). These Likert scales were repeatedly shown in the original survey but not in this appendix for brevity]

Q5 How often do you show your students what you care for, as a part of teaching or engaging in computing? - Required

a) Taking care of yourself (well-being)
- Never
- Rarely
- Sometimes
- Often
- All the time
- Do not know/not applicable

b) Taking care of other humans

c) Taking care of machines/devices/technology

d) Taking care of other living species (plants, animals, etc.)

e) Taking care of the planet

Please elaborate on two of your choices as follows:
A) For one of those types of care where you chose "never" or "rarely", can you explain why you do not show it?
B) For one of those where you chose "sometimes", "often" or "all the time", can you give one example of a situation where you showed it?

Q6 How often do you show your students your emotions that are related to teaching or engaging in computing? - Required

a) Fulfillment
- Never
- Rarely
- Sometimes
- Often
- All the time
- Do not know or want to answer/not applicable

b) Enjoyment

c) Hope

d) Pride

e) Confusion

f) Frustration

Please elaborate on two of your choices as follows:
A) For one of those emotions where you chose "never" or "rarely", can you explain why you do not show it?
B) For one of those where you chose "sometimes", "often" or "all the time", can you give one example of a situation where you showed it?

Q7 What other parts of you (behavior, competence, ways of being, achievements) do you wish that your students see in you and imitate?

Closing

Q8 Thank you for your participation! Is there anything else you would like to share with us?

Q9 Would you be willing to help us by telling us more about your experiences on role modeling as an educator? If so, please leave your email address here or contact Mats Daniels (mats.daniels@it.uu.se). Please note that, If you write your email address here, your responses will no longer be anonymous.

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