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Robots in heterogeneous contexts: Negotiation of co-creative lifelong learning spaces through participatory approaches

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Abstract. Learning is inherently social. This raises several questions that relate to how contexts and spaces can mediate co-creative learning. In this workshop proposal, we refer to the interrelated aspects of space, learning, and embodiment and how these aspects mediate the human-robot interaction. Our assumption is that robots are interpreted variously and used in different ways. We are interested in the interrelation between interpretation and use, which are constitutive for the establishment of different co-creative learning spaces. Reflecting on this leads to an understanding of what to look for in

Participatory Design studies. It matters, for example, whether persons in a nursing home have any say at all in how robots are perceived and in what technical practices robots are to be integrated and adopted. This is a crucial aspect for the appropriation of technical artifacts and for the development of new (E)CSCW or HCI paradigms.

Background

“How to behave in the situation [when different actors perceive robotic artifacts differently], whether you prefer to do this constantly in individual situations or with an entire group, how to deal with the dynamics. These are all things that can be better explained by such studies [on learning processes regarding robots] at some point.” (Paluch and Müller, 2022, p. 23).

This quote is an interview excerpt from our study in which robotic pets were used in a nursing home. One of our research interests was the creation of mutual learning spaces for the residents, care attendants, and university researchers. The care attendant had pointed out that co-creative learning spaces were necessary for developing an imagination on how the usage of robotic pets could be meaningful in different care situations. In our view, such spaces for mutual learning and co-creation are necessary to foster the development of functionally better technologies and reflect on their use with all participants.

We need to co-create spaces for people to appropriate new technologies such as robots (Stevens and Pipek, 2018). For this, three questions are important: (1) How to include spatial aspects in design? (2) What could be learned in various spaces? (3) What role does the body play in human-robot interactions? Thus, we define three interrelated foci:

- (1) The emphasis is on not only developing a specific technology, but also having a space in which to explore a technology. A robot also needs an environment in which it can function and be used (Lindemann and Matsuzaki, 2014). That includes spatial aspects that we would like to emphasize in our Participatory Design (PD) approach (Simonsen and Robertson, 2013).
- (2) How can learning processes be supported through PD? It is not only about how to use technology. One also needs to learn in which situations it is appropriate to use technologies (Cerna et al., 2022).
- (3) The human-robot interaction is characterized by the fact that both the human and the robot have a body. Robots are embodied technical artifacts. This distinguishes robotic systems from other digital technologies (Bartneck et al., 2020, p. 7).

Creation of learning spaces through PD

In PD, emphasis is placed on allowing users to participate in all stages of design. Design ideas are gained by focusing on usage practices, and novel technical possibilities can be explored. This can be achieved by discovering a more creative solution to a problem. With PD methods, it is possible to strengthen mutual learning in an iterative development. In addition to the socio-cultural structures or technical artifacts, this also requires an environment in which collaborative participation is possible. Thus, PD studies need to create suitable learning spaces (Bratteteig and Wagner, 2012; Suchman, 2011). Compared to user-centered design, we would like to use the term PD to emphasize that this is a co-research process in which the emphasis is on the inclusion of all perspectives (Duque et al., 2019).

In co-creative learning spaces, where groups of people from different contexts take part, the sense of technologies could be negotiated together. Negotiating in spaces have been crucial in participatory research methods and Scandinavian design for decades based on the democratic ideal that everyone should have the right to participate in decisions impacting one's own life (Ehn, 1993; Nygaard, 1996). In co-creative learning spaces, this approach has a central importance, as freedom of expression is an essential aspect in successful participation and negotiation, and at the same time contributes to maximizing the learning effect and empowerment (Brown et al., 2014; Ogonowski et al., 2018). Co-creation is consequently always a learning journey (Akhilesh, 2017), which makes it an appropriate format to support learning effectiveness and autonomy (Kaptelinin and Bannon, 2012; Vassilakopoulou et al., 2018).

Learning and empowerment through interaction with robotic technologies

Learning to use technical artifacts is an important practice that remains with people throughout their lives and takes place in various spaces, environments, and situations, covering formal, non-formal, and informal learning (Aoki, 2020). In societal discourse, current debate is about how lifelong and lifewide learning can be designed and supported (Findsen and Formosa, 2011; Fischer, 2000; Zhuang et al., 2017), and in which social contexts learning processes must be placed to generate positive impacts such as empowerment and improved living standards (Carr et al., 2018). For example, scientific studies refer to how older persons can learn technical skills so that they can use different technical artifacts (e.g., Lee and Riek, 2018; Schreurs et al., 2017). There are also a variety of digital technologies that teach people in everyday life (e.g., Cerna et al., 2022; Fong et al., 2021; Johnson et al., 2012; Kuoppamäki et al., 2021; van den Berghe et al., 2019).

In this context, empowerment describes a social construct or interpersonal process between at least two people in which tools, resources, and environments are combined and made available in ways that increase the capabilities of the

empowered persons and develop new skills (Hawks, 1992). This empowerment supports individuals' abilities to make purposeful decisions and thus transform them into desired outcomes. Thus, empowerment not only describes the goal itself, but is also considered a driver for development (Alsop, 2006). Accordingly, it is also necessary to evoke the feeling of empowerment in the participating individuals in advance so that they can efficiently and effectively participate in the negotiation processes of co-creative methods (Fraser et al., 2006).

Human-robot interaction and embodiment

The different aspects of embodiment have been explored in various fields of science and from diverse perspectives, for example in studies in communication and psychology, modern philosophy, HCI, (E)CSCW and sociology. We align our work with existing (E)CSCW and HCI literature on embodied interaction and action (Al-Sada et al., 2021; Ducheneaut et al., 2009; Schmidt, 2018; Yamazaki et al., 2012). Our understanding of embodiment builds on two key points:

“First, that cognition depends upon the kinds of experience that comes from having a body with various sensorimotor capacities, and second, that these individual sensorimotor capacities are themselves embedded in a more encompassing biological, psychological, and cultural context” (Varela et al., 1991, pp. 172-173).

In other words, it is the bodily engagement with the social and physical environment that constitutes the interaction between humans and robots (Dourish, 2001).

Using the term “embodied”, we aim to highlight that both humans and robots interact with the world through their bodies (and not only their minds or software) and this active experience of the world shapes how they perceive their surroundings. The embodied aspect is crucial as it mediates our various human-robot interactions (Klemmer et al., 2006; Lindemann and Matsuzaki, 2014).

Workshop goals and activities

For (E)CSCW and design approaches with participatory research, interdisciplinarity is crucial. We would like to contribute on how co-creative learning spaces can be supported in heterogeneous contexts and what different disciplines can say about learning and negotiation using robots as an example. This offers both workshop participants and organizers an insight into different approaches and a broader picture regarding the concept of lifelong learning in different fields. We thus build on the considerations and results of Cerna et al. (2020) and Cerna and Müller (2021).

- How to augment the physical properties of a robot so that it is possible to make sense of it by the possible users?
- How to organize the socio-materiality of a space including a robot to make it into a negotiation space that enables different forms of learning?
- What skills do people need to be able to negotiate their co-creative learning spaces?
- How to responsibly frame the notion of empowerment that represents heterogeneous actors in PD?
- What new (E)CSCW or HCI paradigms concerning human-robot interaction in heterogeneous co-creative learning spaces can be identified?
- How can we understand learning to deal with robots?
- How to imagine mutual learning among human and non-human actors?

We plan the workshop for one full day. First, right after the acceptance of our proposal, we will go live with our workshop website and immediately send a call for papers to all our networks. We will then prepare all the necessary infrastructures, such as a common document to collect all the relevant information, a place where we will collect all the submitted texts and a Miro board (<https://miro.com/>) for virtual participants. Before the actual workshop, participants will receive the submitted texts in advance to read and prepare for the workshop as well as access to the online common document. In this document, we will keep an updated version of the workshop schedule and other relevant information, such as images, prototypes, findings, ongoing reflections, etc. We will prepare for an offline, online, and a hybrid variant of our workshop. We will use a Miro board and/or a whiteboard as an interactive tool for the workshop so that discussion is directly captured and to evoke discussions among all participants.

Workshop introduction

At the beginning of the workshop, there will be a round of introductions in which the participants and the workshop organizers can introduce themselves briefly. Afterwards, the main topics are introduced: (1) space, (2) learning, and (3) embodiment.

Mini-presentations

Each participant is given the opportunity to describe her or his research focus in a short presentation. Thus, there are several loops in which the workshop participants can present themselves, their contents, and their texts. At the same time, everyone also could familiarize themselves with the scientific directions and focal points of the respective participants.

World Café

Next, we will organize an activity called the World Café (Schley and Balzer, 2020). We will arrange the participants into three working groups, each focusing on one of the challenges connected to our topics: (1) space, (2) learning, and (3) embodiment. Each group will discuss one topic for a specific period and document their discussion, and once the time is up, move to the next table. Each participant will be given the opportunity to share aspects at the three topic tables. Through sticky notes on Miro or notes on the whiteboard, insights are collected and documented.

Common discussion

In the second half of the workshop, the results are collected and classified according to our topics of (1) space, (2) learning, and (3) embodiment. This categorization is discussed among the participants to capture important categories and dimensions of the identified aspects. An organizer takes written notes throughout the session to document the progress of the workshop.

Next steps

We collect results, central aspects, and further thoughts. Through this we expect to be able to define new paradigms and how co-creative learning spaces for handling robots can look like in heterogeneous contexts.

Table I. Workshop Agenda

Time	Activity
9:00 - 09:10	Brief workshop introduction
9:10 - 10:30	Mini-presentations and discussion of pictures, sketches, wireframes, mockups, and prototypes
10:30 - 12:00 (including break)	World-Café: Three topic tables with the focus on space, learning, and embodiment
12:00 - 13:00	Lunch break
13:00 - 15:00 (including break)	Common discussion of the three topics based on the results from the World Café
15:00 - 16:00	Next steps

Submission details

Potential participants, who are interested in the workshop, will be asked to submit a position paper. This paper should have no more than 5 pages including references.

We would like to encourage potential authors to refer to our three workshop topics in their contributions. Papers can address philosophical or theoretical considerations, present methodological insights, or empirical cases. Submissions will be sent by email. The organizers of this workshop will review the submitted papers and select them according to their quality, innovation as well as coherence with the three thematic foci: (1) space, (2) learning, and (3) embodiment.

- March 14, 2022: Workshop website is published together with the call shared in all our communication channels;
- April 19, 2022: Deadline for paper submission;
- May 2, 2022: Acceptance notification;
- June 27 or 28, 2022: Participation and presentation.

We will notify participants of acceptance at an early stage so that both the early bird rate can be selected, and conference travels can be arranged in case of the offline or hybrid variants of the workshop.

Post-workshop and expected outcomes

Our plan is to publish the submitted papers. To do this, we plan to publish a workshop report in IRSI – an open source online journal (<https://www.iisi.de/international-reports-on-socio-informatics-irsi/>), where we will publish papers revised by the authors after the workshop. Finally, we also want to work with the workshop participants to extend their research further by inviting them to submit to a journal special issue on the workshop's topic. To be able to continue the discussion around the topics of robots, we will agree on creating a communication channel with the participants. It is also pursued to enable a sustainable cooperation between the participants and to enable a future collaboration in production or research (Obaid et al., 2016).

Organizers' short bio

Richard Paluch is a PhD Student at the University of Siegen, Germany. His research focuses on the robotization of care. Possibilities and limits of robotic systems for nursing are analyzed and standards for reasoning and assessment are developed for people in need of care.

Dr. Katerina Cerna is a HCI lecturer at the Division of Human-computer interaction, Gothenburg University, Sweden. She has a longstanding interest in combining learning and PD, especially in enabling citizens in co-creating their own solutions and the necessary knowledge they need to develop to do so. Currently she is exploring these topics in the fields of HCI, sustainability and well-being.

Dr. Mohammad Obaid is an Associate Professor of HCI and the Head of the Interaction Design Unit at Chalmers University of Technology, Gothenburg, Sweden. He worked at several international research centers including the Human Centered Multimedia Lab (Germany), HITLab NZ (New Zealand), and the Social Robotics Lab (Sweden). Dr. Obaid is one of the founders of the Applied Robotics Group at Chalmers University of Technology. He also (co-)authored of over 78 publications within the areas of his research interests on Human-Robot Interaction and Human-Computer Interaction.

Dr. Galina Volkova is Junior Research Fellow. Among her main professional interests – features of researchers and engineers as a specific group of highly qualified knowledge workers (including those involved in robotics), their skill sets and lifelong learning patterns.

Michael Seidler is a PhD student at the Institute for Social Science Research (ISF Munich, Germany). His research focuses on work, human-machine interaction as well as learning and development. He is particularly interested in thinking about how a human-machine interaction could systematically promote informal workplace learning for human and non-human actors.

Tim Weiler is a research associate at the University of Siegen, Germany. His research focuses on PD and Co-Creation in health care. Hybrid interaction systems for maintaining health even in exceptional situations are analyzed and a framework for co-creative methods is to be defined.

Prof. Dr. Claudia Müller is an Assistant Professor of Socio-Informatics, specializing in “IT for the ageing society” at the University of Siegen, Germany. Her expertise is PD with and for older adults, vulnerable user groups and local communities. She is representative chairwoman of the commission of the Eighth Federal Government Report on Older People.

Recruitment and participants selection

Our goal is to include people from different disciplines in this workshop. The workshop is planned for 10 submissions with approximately 15 participants – this does not include the organizers. To recruit an adequate representation of participants, we will send out our call via email lists connected to the different institutions. These include HCI and (E)CSCW lists on the one hand, and interdisciplinary mailing lists on the other.

These include, for example, EUSSET email list, Research Network “Ageing in Europe” of the European Sociological Association, the German Network for Participatory Health Research (Netzwerk Partizipative Gesundheitsforschung) (PartNet), Health Geography, feminist geography, and the German Research Center for Artificial Intelligence (Deutsches Forschungszentrum für Künstliche Intelligenz) (DFKI).

In addition, our research partners will be informed about this call. Since these are interdisciplinary EU projects, we will thus be able to reach out to different disciplines as well. Finally, we will set up a website that we will use to promote our workshop. We want different disciplines to have their voice in our workshop, so we will select participants according to their perspective on our focus of interest.

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