International Journal of Social Robotics
https://doi.org/10.1007/s12369-025-01230-9

How Could Social Robots Support Societal Participation? Findings from Five Design Workshops with Young People

Salla Jarske[1] · Kirsikka Kaipainen[1] · Aino Ahtinen[1] · Jari Varsaluoma[1] · Kaisa Väänänen[1]

Accepted: 6 September 2024

Abstract
Societal participation encompasses individual and collaborative activities aimed at influencing decisions that affect a person's life. Engaging young people in societal participation is important for democratic and sustainable societies, but various structural and psychological barriers hinder participation. Digital technologies show promise in lowering the barriers by providing young people with new channels and means to participate. However, such technologies must be co-designed with youth to ensure they address real needs. To explore the potential of social robots in this context, we conducted five design workshops with high school and university students ($N = 47$). In the workshops, participants ideated social robots intended to support youth participation in society, starting with the robot's purpose and continuing with defining its interaction methods and appearance. Through a qualitative analysis of participants' design conversations and the resulting 24 robot ideas, we identified four themes related to different contexts of societal participation: democracy, environmental actions, social inclusion, and well-being. Participants imagined robots for various purposes, such as conveying feedback, educating, assisting in decision-making, facilitating discussions, and therapeutic interactions. Based on the findings, we outline four potential interaction roles that appear feasible for robots supporting societal participation: informing, stimulating, simulating, and mediating. Although the findings are exploratory, the identified contexts and roles can serve as inspiration and a framework for further research to study the possible benefits and challenges of social robots in the context of societal participation.

Keywords Young people · Societal participation · Social robots · Civic robots · Design workshops

1 Introduction

Providing citizens with equal and accessible opportunities for societal participation is considered important for democratic and sustainable societies [1]. Societal participation can manifest in individual actions, such as voting, consumption choices, or sharing posts in social media, or in collaborative efforts, such as organizing (or taking part in) demonstrations or strikes, or engaging in associations [2, 3]. Societal participation encompasses both local and global levels, as well as informal and formal activities, including democratic decision-making. Ensuring inclusive societal participation for young people is especially crucial, as they will be impacted by current decision-making but are often unheard by decision-makers.

In this paper, we use the term 'young people' to refer primarily to people transitioning from childhood to adulthood, within the age range of 15–24 years [4]. Young people are unique in that they are gradually acquiring equal rights and responsibilities to participate in society in the same way adults do (e.g., voting rights, employment, managing finances) [5]. They also face unique generational issues such as globalization, climate change [6], and different political ideologies or disputes. Many young people are concerned about societal issues but encounter structural barriers, such as voting age or lack of opportunities, as well as psychological barriers, such as disinterest or distrust in participation processes, or they lack the necessary skills to participate and take action [7–9]. Increasingly, young people are turning to digital forms of participation [10]. Barriers in digital environments seem to be lower for young people than in more traditional forms of participation, and digital technologies can offer engaging ways for youth to express their views on societal issues and take part in social movements [9]. However, digital

✉ Salla Jarske
salla.jarske@tuni.fi

[1] Faculty of Information Technology and Communication Sciences, Tampere University, Tampere, Finland

Published online: 28 February 2025

environments come with their own set of barriers, including harassment, trolling, misinformation, and data security breaches [10]. Expanding participation opportunities through technologies embedded in young people's everyday physical environments could address several structural and psychological barriers. In this paper, we focus on exploring the potential of embodied and social technologies—social robots—to encourage, facilitate, or enhance societal participation among youth in their own environments and contexts (cf. [11]).

Social robots are generally understood as autonomous machines or applications that can interact socially and serve humans [12]. While social robots can take many physical forms, they share the common goal of exhibiting behaviors that people can interpret socially [13]. Social robots have shown promise in contexts such as elderly care [14], autism therapy [15], and mental healthcare [16]. They have also been explored in the domain of education [17, 18], where their potential benefits as embodied social technologies include providing personalized, engaging learning experiences and facilitating social interaction between learners [19]. However, in ordinary social environments, robots have not yet been perceived with much value beyond entertainment (e.g., [20, 21]). Given the promise of robots in education and mental health, it seems worth exploring whether they could serve as an engaging medium for supporting societal participation of youth, and in which contexts they could provide value over other technologies.

While societal participation is a rare use context in social robotics research, some previous studies have examined robots in supporting the teaching of children's rights [22] and teaching environmental habits to children [23]. In general, youth have received less attention in social robotics research compared to elderly and children [24]. Our previous research also indicates that adolescents find the concept of using social robots and chatbots in the context of societal participation acceptable [11, 25, 26]. This suggests potential for further research in this context with young people, using co-design approaches to better understand how robots could address real needs and lower participation barriers.

In this paper, we explore the potential contexts and purposes for *civic robots*, that is, social robots designed to support people in societal participation [26, 27]. Our research approach is Research through Design, in which artefacts are designed and subsequently analyzed to identify opportunities for technology utilization and to reflect on their potential impacts on the world [28]. For this study, we collected data from five exploratory design workshops with high school and university students, as engaging youth in the design of technologies allows them to voice their perspectives [3, 29]. The purpose of the workshops was to generate ideas and concepts regarding robot-supported or robot-mediated societal participation. The research question for this paper is: *What forms of societal participation are addressed in social robot concepts designed by young people?*

The contributions of this study include a variety of social robot concepts, which provide a deeper understanding of the potential uses of social robots to support societal participation of youth, and four possible interaction roles for civic robots. These findings can serve as inspiration and a framework for further exploration in the research and design of robots for societal participation, extending beyond the youth age group.

The rest of the paper is structured as follows: In Sect. 2, we provide further background and review related work relevant to the present study. In Sect. 3, we describe the workshop setup and procedure, as well as the data collection and analysis methods. In Sect. 4, we present the generated robot ideas according to the main themes, and in Sect. 5, we discuss the ideas further, outline the design implications, and report the study's limitations. Section 6 concludes the paper.

2 Background and Related Work

2.1 Societal and Civic Participation of Youth

Societal participation broadly encompasses various participatory activities in both society and the global world [3], while civic participation refers specifically to local communities and their decision-making [30]. Active youth participation contributes to a more democratic society by involving youth in the institutions and practices that affect their lives [8]. However, structural obstacles, such as voting age, limit youth participation. Additionally, a significant social-psychological barrier is that young people often do not perceive themselves as having the ability to create change in society, or they feel uncertain about resources or how to take action [8]. They may also struggle to articulate their concerns in official political language, lacking the appropriate language to discuss political issues relevant to them [31]. Adults often impose limits and conditions on youth, portraying them as less capable citizens or somehow "troubled" [8], or view youth as disinterested in politics [32].

Nevertheless, young people want to be heard and seek ways to participate, but many feel that the official participation channels are not responsive to their needs [31]. As a result, youth adopt informal and individualized methods in everyday life to address their concerns, and these methods do not easily conform to the traditional participation paradigm that emphasizes formal practices [10, 31]. In a study by Harris et al. [31], it was found that recycling and donating were among the most common forms of everyday participation for youth. Regarding environmental concerns, recycling directly engages individuals in their agenda without requiring access to formal resources and yields immediate results.

Signing petitions, making statements through artistic expression, listening to political music, and discussing issues with others were also quite common. Hirzalla and Zoonen [33] additionally identify consumption as a form of individual participation, consisting of choosing what products to buy, and in turn, what to 'buycott'.

Everyday participation is valuable, but for young people to develop their abilities to contribute to broader societal issues, it is important for them to acquire civic knowledge, such as understanding citizenship, political institutions, human rights, environmental concerns, and global issues. The contexts in which young people develop their understanding of civics and citizenship include the home, peer groups, schools and classrooms, and the wider community at the national and regional levels [30]. Sharing ideas and opinions with others through discussion can also be considered a form of societal participation [33]. Discussion is a central aspect of deliberative democracy, a process in which people from diverse backgrounds engage in dialogue and shared meaning-making to shape policies that will influence their lives [34]. In schools, an open classroom climate that encourages discussion can lead to increased civic knowledge and engagement [35, 36]. While discussing political issues is generally preferred with intimate networks involving trust and belonging [31], engaging in political and social discussions with peers can become a habit that grows easier and more comfortable over time [37]. Overall, since youth participation takes many forms, designing ways to lower its barriers requires participatory research to understand young people's needs and preferences [38].

2.2 Supporting Youth's Societal Participation with Technology

Youth can benefit from participation opportunities online due to the potential obstacles in offline activities (such as demonstrations), lack of resources, or restrictions set by adults [33]. Digital participation broadly refers to digital and online activities, including social media services and discussion forums, answering surveys, reading or writing blogs, and also forms of political participation such as electronic voting [9, 39]. For some youth, the internet provides an informal space to engage in public discussions and express themselves [31]. However, some youth may view societal discussions on public social media forums as exposing them to aggressive discourse and conflicts [9]. Therefore, there is a need for digital forums that provide a safe environment for societal discussions. For example, in Finland, a digital citizen council was designed to support a low-threshold societal participation of youth in safe environment [3]. In offline activities, other kinds of technology-aided solutions could be beneficial in lowering the barriers to participation.

It has been found that encouraging youth to use digital media to create and share user-generated content (e.g., videos, poetry, and music) has potential to increase their interest in political activities [40]. Kahne et al. [41] have also identified that youth participation in "online, nonpolitical, interest-driven activities" may lead to engagement in political activities, such as volunteering, community problem solving, and protesting. From this perspective, engaging youth in the design of technologies, especially those that aim to support youth societal participation, has potential to increase the participants' interest in societal matters in the future. Furthermore, participatory design activities can support learning about societal topics by encouraging youth to reflect on issues relevant to their own situation, such as challenges in education [42] and news literacy [43].

2.3 Social Robots Designed for Youth

Young people's views and perceptions of robots can be seen as unique when compared to those of children and adults [44]. Compared to adults, adolescents have been found to have more positive attitudes toward using robots, for example in psychotherapy [45]. This may be due to teenagers being generally more ready to adopt new technologies [46]. However, in the workplace context, Fenech et al. [47] found that generation Z (i.e., people born between 1997 and 2012) has an undecided attitude toward robotics, which may lean toward apprehension, fear, and anxiety. In some previous studies, young people have been engaged through a participatory design approach to ideate social robots for mental health. Björling and Rose [29] conducted an extensive social robot design challenge with young people in a school environment, drawing from previous research suggesting that robots can have therapeutic effects on humans' emotional responses. The aim of the challenge was to design a social robot to help reduce stress, and the study resulted in various ideas for robot embodiments and features [48]. The participants engaged in design sessions that included activities ranging from drawing to storyboarding and testing a robot prototype with peers. In another study conducted during the COVID-19 pandemic, Alves-Oliveira et al. [49] carried out a four-week co-design process with adolescents, shipping design kits and engaging adolescents through a series of online meetings. The participants, aged 14–18, designed a prototype to support their mental well-being at home during the pandemic. The adolescents were tasked with creating an identity for the robot, ideating interaction scenarios, and sharing their designs through online sessions. Robots were imagined in three types of roles: as coaches to motivate youth in activities by providing assistance and motivational messages, as companions to help in home tasks, and as listeners with whom youth can practice self-expression. Some participants, however, expressed doubt about whether robots could fill such

roles, as they appeared too strange as interaction partners compared to humans. Thus, design activities can also provide participants with an opportunity to voice criticism and highlight why a particular technological solution may not work.

A few studies have investigated interactions between adolescents and social robots. An Ecological Momentary Assessment Robot (EMAR) was envisioned for gathering stress and mood data from high school students and for relieving student stress, based on robots' potential in engaging youth for data collection and mini-interventions [24]. In the study, 45 high school students were observed interacting with the low-fidelity prototype. The study found that teens showed engagement and empathy toward EMAR. In group interviews, participants expressed interest in having a robot as a potential talking partner about stress, particularly because the robot represented a different type of interaction partner compared to friends or adult personnel at school. This is a promising finding considering the context of societal participation, as a robot could offer young people with an engaging way to reflect on psychological barriers to participation or offer concrete assistance.

In a study with a younger age group, Chew et al. [22] designed a "Robot Activist Model" with the Nao robot platform. The agenda was to promote child rights awareness with an educational robot that introduces child rights to primary school children in Malaysia. The robot was not designed to replace human educators but to support them. The prototype was designed to introduce The National Human Rights Institution of Malaysia (SUHAKAM) and provide answers to questions (Q&A). After delivering 'factual and heavy' information, the robot would try to attract the students' attention with engaging behaviors. It would also offer to play a brief game after the Q&A as a reward for listening. The authors suggest that the robot's potential lies in increasing engagement and interest when delivering information to children, which indicates that civics education could be a domain worth exploring further in social robotics.

In the domain of societal participation, young people's perceptions and attitudes towards social robots have been studied, but there seems to be a lack of research on how interaction with civic robots should be designed. In a scenario evaluation study [11], 15-year-old students evaluated of three robot scenarios illustrating a robot aimed at persuading young people to engage in societal participation. The scenarios depicted a robot encouraging youth to ideate climate actions, a robot interviewing young people about their well-being, and a robot approaching young people in a public place to attract them to a stand about societal participation. The study found that while participants generally found the idea of social robots as persuaders to participation acceptable, they disliked pretentiousness in the robot's communication and emotional expressions and expressed concern about information security and transparency. Interestingly, the findings partially contrast with an experiment with high school students [50], which indicated that perceived trust and companionship with a robot were higher when the robot expressed vulnerability, and that the more expressive the robot was, the more youth would disclose information. This apparent contradiction suggests that the role, purpose, and use context of the robot's use determine the appropriateness of its behavior. In another study of adolescents' perceptions [27], young people between 14–21 years old imagined social robots as potential social facilitators or assistants in decision-making, emphasizing the perceived objectivity of robots. However, the authors observed that many participants struggled to conceptualize how social robots could assist in societal participation, suggesting that a stronger participatory approach with opportunities for hands-on prototyping could provide deeper insights to whether social robots could be designed to address youth's unmet needs.

3 Methods

3.1 Study Design

The focus of this study was to explore how young people imagine the possible contexts and interaction roles for robots that could support societal participation of youth (i.e., civic robots). The study follows a Research through Design approach where the purpose is to gain understanding on what would be a right thing to make to address a particular problem, and where the problem itself can be reframed through the design process [28]. In Research through Design, design workshops are a common practice to collect ideas about new forms of interaction and increase understanding of people's needs related to the problem in question [51]. Hence, to gain understanding of youth's preferences on potential contexts of use and purposes regarding civic robots, we conducted five 2–2.5-h design workshops. As our definition of young people covers the 15–24 age range that contains age groups of middle adolescence (15–17) and early adulthood (18–24) that have in general large differences in personal contexts and rights, we aimed to involve a representation of participants from both age groups. Thus, three of the workshops were conducted with high school students and two with university students. The workshops took place between February 2020 and January 2021. The first two workshops were conducted on university campus and the rest were conducted online via Zoom videoconferencing application due to COVID-19 restrictions enforced in March 2020.

In the workshops, participants worked in groups of 2–5 students using a structured two-part canvas to ideate and design a civic robot concept. The canvas was inspired by

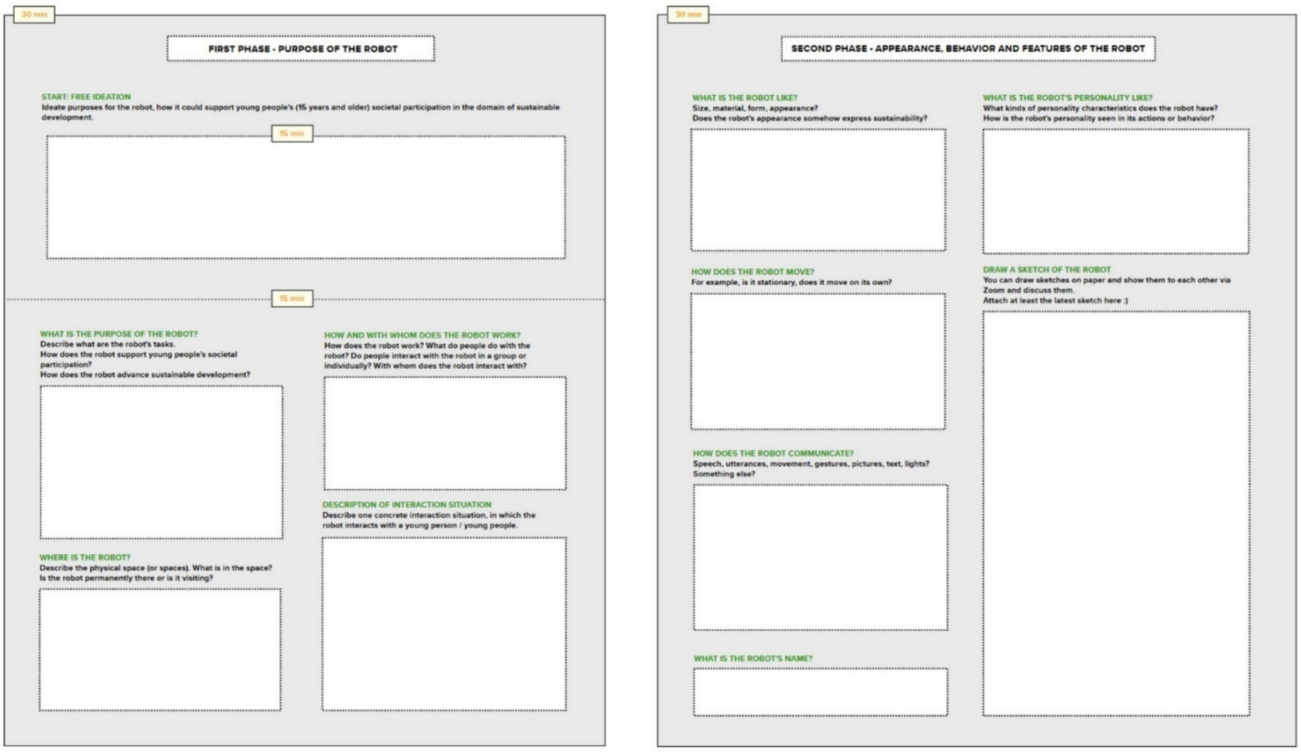

Fig. 1 Online workshop design canvas (workshop W3), translated into English from Finnish

Axelsson's social robot co-design canvases [52]. The elements in the canvas were designed to provide structure for group work, starting from the problem to solve (i.e., the purpose and context for the robot) and continuing to the more detailed design of the robot and its interaction modalities. Iterations to the workshop content and the canvas structure were made between the workshops based on participants' feedback and facilitators' observations (see Sect. 3.3.2), and the paper canvas used in the on-campus workshops was transferred to online format (see Fig. 1) implemented on the Mural online visual collaboration platform (https://mural.co/).

3.2 Participants

In total, 47 people participated in the five workshops. The language of all workshops was Finnish. Each workshop had from 6 to 15 participants, divided into groups of 2–5 people (altogether 15 groups), and from 3 to 4 facilitators. Details of the workshops and their participants are described in Table 1. High school students were recruited through their teacher, and they participated in the workshops during their school day. The online workshops for high school students (W4 and W5) were divided into two 1.5-h sessions organized on two separate days to accommodate the participants' school schedules. Participation in the study was entirely voluntary and had no influence on the students' grades. Ethical approval for the workshops with high school students was acquired from the officials of the city of Tampere. University students were recruited through personal connections and networks. Majority of participants had no prior experience of robots.

3.3 Workshop Process

The workshops consisted of four phases: introduction, ideation of the robot's purpose, design of the robot's appearance and personality, and closing. Participants were asked to fill in a consent form and a background information questionnaire in the beginning of on-campus workshops or, in online workshops, a few days prior to the workshop via an online form implemented with the LimeSurvey software.

At the beginning of the workshop, the facilitators provided a brief introduction to the topic as well as the definition for social robots. Social robots were defined based on the definition by Bartneck and Forlizzi [53] as physically embodied robots that communicate and interact with people following the behavioral norms of human interaction. To provide initial inspiration for imagining physical appearances for their designs, images and animated GIFs of different robots were shown to participants, ranging from existing robot models to familiar sci-fi characters.

Table 1 Details of the workshops and participants

Workshop ID	Setting	Time	n of participants and groups	Age, mean (range)	Female (%)	Prior experience of robots (%)
W1	On campus, university students (technology)	Feb 2020, 2.5 h	7, 3 groups	19.9 (19–20)	13	13
W2	On campus, high school students	Mar 2020, 2.5 h	15, 4 groups	16.7 (16–18)	7	33
W3	Online, university students (design)	May 2020, 2 h	7, 2 groups	28.7 (21–41)	57	14
W4	Online, high school students	Dec 2020, 2 × 1.25 h	12, 4 groups	17.4 (17–20)	67	17
W5	Online, high school students	Dec 2020 & Jan 2021, 2 × 1.25 h	6, 2 groups	17.7 (17–20)	33	0

3.3.1 Workshop Introduction

In the introduction, facilitators first introduced themselves to the participants. One of the facilitators explained the purpose of the research and the workshop process in detail to the participants and described the potential abilities of social robots, showing example pictures of different kinds of robots. The concepts of societal participation and sustainable development were also explained briefly with examples and inspirational keywords (e.g., human rights, equality, preventing bullying, recycling, energy savings, consumption reduction). The environmental, social, cultural, and economic domains of sustainable development were presented to inspire ideation of concrete purposes for societal participation. The participants were then divided into groups (in online workshops, using Zoom's breakout rooms). Each group's discussion during the rest of the workshop was audio recorded.

3.3.2 Ideation of the Robot's Purpose

The ideation of the robot's purpose started with an approximately 10–15-min free ideation session in groups. In on-campus workshops, participants were instructed to write any ideas about possible purposes or usage situations for the robot on post-it notes, and facilitators circulated around the room to encourage ideation and answer possible questions. Since the aim of our research was to explore the broad context of societal participation of youth, we wanted to allow the participants to creatively come up with any kinds of ideas related to what they viewed as societal participation, while also focusing on purposes related to different sustainable development domains. Participants were asked to freely ideate potential use scenarios that they find either appealing, interesting, or feasible before choosing one of them to design further. They were also told not to focus merely on what is currently technologically possible. In online workshops, each group had a researcher present in the breakout room, and participants were instructed to place their ideas on post-it notes on the online canvas.

After the free ideation, the participants were asked to choose one of their ideas for further development, and work with questions provided on the design canvas to ideate the application domain including the context of use and tasks for the robot, as well as design an interaction scenario through describing or drawing the usage situation. They were given around 30 min for this task, after which each group was asked to explain their initial concept to others, who could provide comments.

The canvases include two versions, the original versions for the physical workshops (Figs. 2, 3) and a slightly altered version for the online workshops (Fig. 1). The original canvas used in W1 was changed for W2 to include comics-style panels to encourage the participants to describe an interaction scenario (see Fig. 2, bottom right corner of the canvas). When transferring the canvases online, the phrasings and order of the questions were modified slightly based on the experiences of the first workshops. Regarding this paper's focus, the most significant modification was demoting the title "Promoting sustainable development" in the first box (see Fig. 2) to a sub question under the title "What is the purpose of the robot" (see Fig. 1) because the original format appeared to lead some participants to focus mainly on sustainable development and forget to consider societal participation more deeply.

3.3.3 Design of the Robot's Appearance and Personality

During the second half of the workshop, participants were to focus on the appearance and personality of the robot, thus

Fig. 2 Canvas for ideating the robot's purpose. This canvas version is from workshop W2 and translated into English from Finnish

filling in the second part of the canvas (see Fig. 3). The groups were given approximately 40 min for this task. The appearance of the robot was described by written text and drawings in all workshops except for W1, in which participants were additionally given silk clay to sculpt their robot models. We originally planned to use silk clay in all the workshops following W1, but as the workshops had to be moved online due to COVID-19, this was not possible.

3.3.4 Closing

Each group was asked to describe their final concept and show their design to other groups, who could comment and ask questions. Finally, participants filled in a feedback questionnaire.

3.4 Data Collection Methods

In addition to the design artefacts (canvases and clay sculptures) produced in the workshops, we also collected data about the design process. Data were collected by individual background questionnaires, canvases produced by the groups, audio recordings from each group, silk clay sculptures created by the groups in workshop H1, and individual feedback questionnaires. Pictures or screenshots of the canvases were taken after the workshops and any personally identifiable information was removed from them. The sculptures were also photographed. The audio recordings were transcribed. The collected data were qualitative except for the quantitative numerical scales in the feedback questionnaires. The feedback questionnaire consisted of statements (e.g., *"It felt meaningful to participate in the workshop"*; *"The workshop topics were interesting or important to me"*) that the participants were asked to rate on a 7-point disagree-agree scale, and open-ended questions about the positive aspects and what to improve in the workshop, what participants learned in the workshop, what they considered as strengths of social robots, and what they considered as most important aspects in the robot they designed.

3.5 Analysis

The analysis process followed the qualitative content analysis approach [54], which included a systematic coding of the transcripts and canvas contents and an iterative process

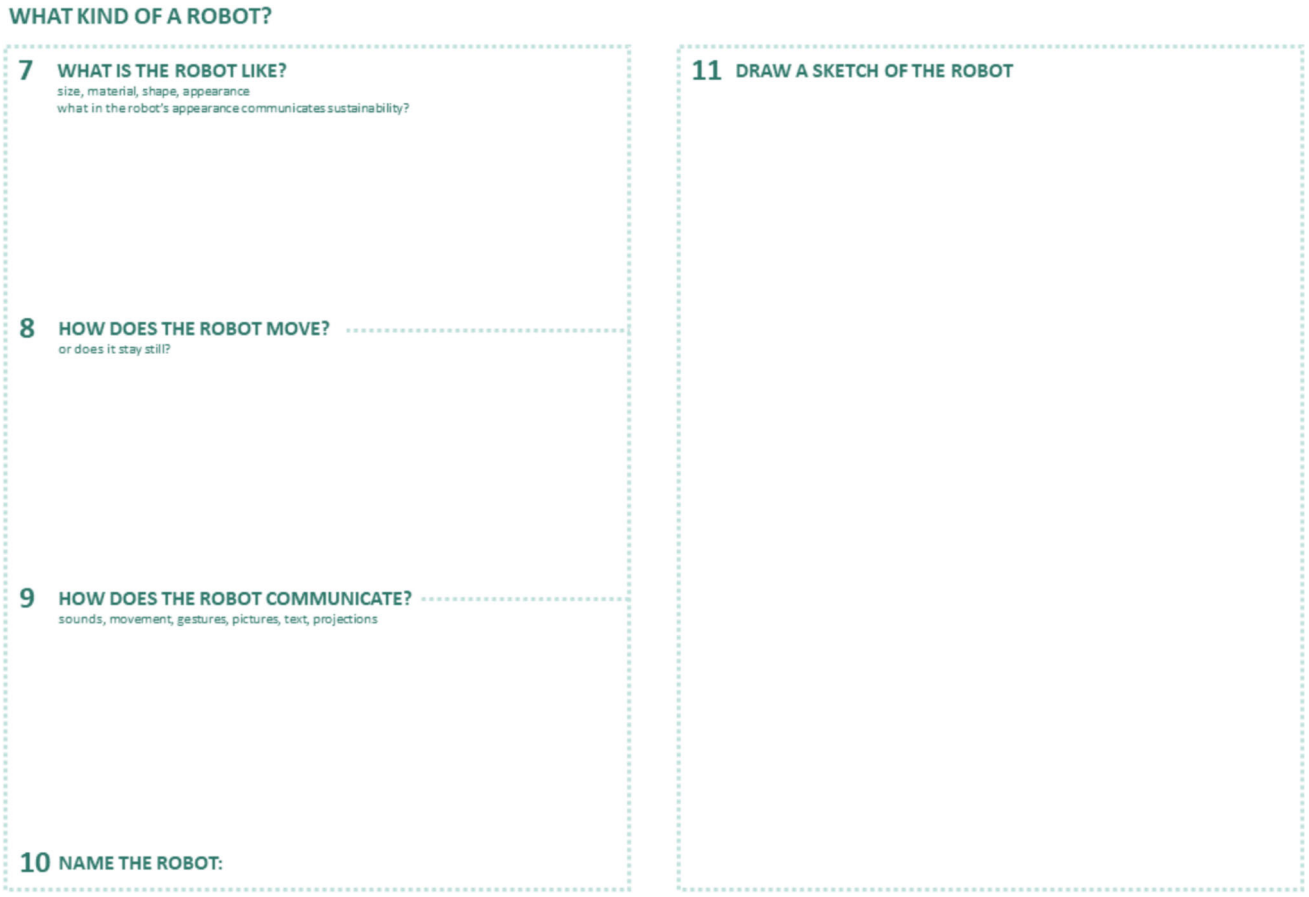

Fig. 3 Canvas for designing the robot's appearance and personality. This canvas version is from workshop H1 and translated into English from Finnish

of categorizing the coded contents into themes. First, the first two authors familiarized themselves with the data and agreed on shared rules for coding. Then, a preliminary coding of the qualitative data was conducted in ATLAS.ti based on the agreed upon rules, and sections of the data that were not related to the present research focus were omitted from analysis (e.g., the appearance of the robot). In our analysis, each robot idea that was mentioned (along with related discussions) in the groups' conversations was systematically identified from the transcripts. Through coding, we grouped together similar ideas or thoughts from different workshops. In our analysis, we paid attention to how the participants talked about, justified, or critiqued the robot ideas and design choices. Commonly ideas were justified based on a particular obstacle that the participants felt relates to societal participation from their own point of view (e.g., lack of access, lack of information), but we observed that a lack of justification was equally important to the overall understanding of the data. During the second phase, a second, careful reading and analysis of the robot ideas and discussions related to them was conducted by the first author. Sub-themes that illustrate a key idea (a purpose for a robot) were constructed, and these were further grouped into broader themes based on their application contexts (presented in Table 2).

As it was not possible to ask the participants to clarify certain points, we deemed it important not to draw direct conclusions from the participants' discussions by assuming that they represent overall needs or desires of youth. Rather, the discussions served to illustrate the various ways social robot technologies were imagined to address problems relevant for the participants, recognizing that while the participants are not experts on social robots, they are experts on their own situations and experiences.

4 Findings

As detailed above, participants engaged in free ideation at the beginning of the design session and selected one robot idea to further develop into a concept, specifying the robot's purpose, context of use, appearance, interaction scenario, and behavior style. All robot ideas identified from the participants' discussions and canvases are presented in Table 2.

Table 2 The civic robot ideas from the workshop participants. The ideas are marked as robot concepts [c] or suggestions [s], and associated with themes regarding their context of use

Workshop	Group ID	Civic robot ideas	Description	Democracy (n = 7)	Environmental actions (n = 5)	Social inclusion (n = 7)	Well-being (n = 5)	Other (n = 3)
Workshop 1: face-to-face with university students	U1	R1. Recycling champion [c]	Provides positive encouragement when recycling		x			
		R2. Feedback listener [s]	Gathers feedback from citizens	x				
		R3. Rantbot [s]	Relives stress by listening to people's emotional outbursts				x	
	U2	R4. Library assistant [c]	Assists in finding books and discusses recent news	x		x		
		R5. Election assistant [s]	Attracts people to voting areas and assists with identification	x				
	U3	R6. Home robot [c]	Serves the family in various ways and encourages societal discussions	x		x		
		R7. Political debater (S)	Engages in arguments with people about political ideas	x				
		R8. Product adviser (S)	Compares the environmental impact of products for customers		x			
Workshop 2: face-to-face with high school students	H1	R9. Intelligent refrigerator [c]	Cooks, tracks a person's eating habits, and provides company			x	x	
		R10. Icebreaking robot [s]	Helps persons socialize with new people			x	x	
		R11. Election advertiser [s]	Informs about elections and encourages voting	x				
	H2	R12. Recycling guard [c]	Keeps the school or home clean, and enforces recycling		x			
	H3	R13. Teacher's assistant [c]	Provides personalized teaching on school subjects during class					x
	H4	R14. Shop assistant [c]	Helps with collecting groceries					x

Table 2 (continued)

Workshop	Group ID	Civic robot ideas	Description	Democracy (n = 7)	Environmental actions (n = 5)	Social inclusion (n = 7)	Well-being (n = 5)	Other (n = 3)
Workshop 3: online with university students	U4	R15. Financial advisor [c]	Creates financial plans and teaches about savings and investments			x		
		R16. Garbage collector [s]	Collects trash and invites people to learn about recycling		x			
	U5	R17. Everyday skills teacher [c]	Teaches various skills needed in early adulthood			x		
		R18. Support robot [s]	Listens to people's concerns and provides support				x	
Workshop 4: online with high school students	H5	R19. Translator [c]	Translates languages during classroom teaching			x		
	H6	R20. Translator [c]	Translates social interactions			x		
	H7	R21. Civics teacher [c]	Teaches about society	x				
	H8	R22. Social support robot [c]	Provides unbiased social support for those who are bullied				x	
Workshop 5: online with high school students	H9	R23. Recycling champion [c]	Helps at recycling stations, making each visit unique and fun		x			
	H10	R24. Counsellor's assistant [c]	Allows people to sign up for guidance counselling at school					x

These include potential rough ideas discussed during brainstorming (referred to as 'suggestions' in the table) and the final concepts, all treated equally as civic robot ideas. The groups produced altogether 24 individual robot ideas (15 concepts and 9 suggestions).

To illustrate the variety of use contexts addressed in designs, four themes were constructed through the analysis: Democracy, Environmental actions, Social inclusion, and Well-being. Specifically, these themes organize the robot ideas according to their approach to societal participation, with each theme addressing unique needs and use cases for robots. Table 2 shows the distribution of ideas across the themes, with some concepts encompassing aspects of more than one theme. The final column in Table 2 labelled as "Other" is reserved for three ideas that fell outside the scope of present workshop and represented generic service roles for robots. In these cases, the aspect of societal participation was absent from the design canvas and the group discussion to the extent that no clear suggestions for civic robots were identified.

In the following subsections, robot ideas under each of the four aforementioned themes are presented with examples and quotes from participant's discussions. The ideas categorized as "Other" are omitted as out of the scope. This paper does not report on the appearances or behaviors that were designed unless they are relevant to the scope of discussion or used as example concepts. One robot idea from each theme is illustrated to provide more detailed examples of designs. In the Discussion section, we further examine and evaluate the potential application scenarios of civic robots based on the reported ideas, and clarify the forms of societal participation that they exemplify.

4.1 Democracy

The first theme broadly concerns aspects of democratic civic participation, defined primarily by citizens' involvement in decision-making and engagement in societal discourse. Examples of these ideas include a city robot that listens to citizens' ideas, educational and conversational robots that help people understand society and politics, and a home robot that encourages discussions.

4.1.1 Providing Accessible Channels to Convey Feedback and Ideas

University group U1 suggested that robots could serve as channels for citizens to convey ideas and feedback to the city, functioning as intermediaries between citizens and decision-makers (R2): *"In some shopping center, some space where you can go tell about some development ideas for the city and stuff like that."* The group felt that the traditional methods of conveying ideas through official channels require effort, which can make participation less motivating: *"How many really… even if you have an idea, or something that you don't like, how many actually participate (…) you have to go to some internet site to fill out some form. You have to do something. At the end of the day that is a lot to ask."* Thus, the group suggested that robots could increase citizens' societal participation by providing an alternative way to share opinions at certain locations. Compared to humans, robots were considered neutral, allowing people to interact with them in ways they may not interact with a person, especially when giving negative feedback: *"To a human it's quite difficult if you want to say that you don't like what someone is doing."* Furthermore, university group U2 deemed robots as generally promising platforms for conveying feedback because they could provide more engaging interactions: *"You could get something extra out of it, and maybe people would rather give feedback to a sympathetic robot than to a mere screen."*

4.1.2 Informing About Participation Opportunities

Information and knowledge about how society operates and how one can participate were identified as potential needs among young people. For example, university group U4 reflected that youth may not fully understand what participation in organizations and politics practically entails: "*I feel that at least for me during high school years… I did not have much information about how to participate."* To address this, robots were envisioned as potentially useful and practical information sources: *"A robot could be useful for realizing important things"* (H7) and *"guide people toward efficient participation ways methods"* (H7).

4.1.3 Educating Neutrally About Politics

Presenting political topics was considered a potentially appropriate and interesting application area for robots, as illustrated by several groups' discussions. Groups U1 and H2 suggested that a conversational robot could be equipped to communicate about political ideas: "*You could ask something about elections, or what a specific candidate's views are about these things and so on"* (U2); "*It could put all the parties and how they work, and all these things, and you could ask questions from it"* (H2). Once again, it was suggested that social robots could be suited for this task because they are perceived as more neutral communicators than people: *"It removes the politician's profile. Only the ideas are left. And you start to think that maybe the ideas are worth thinking about too"* (U3). Additionally, group U5 discussed whether robots could be programmed to engage in political debates, as argumentation about political ideas was considered important for developing one's political positions: *"Having the ability to discuss is good because (..) when you get to discuss with someone you find the happy medium"* (U5). A robot, due to its neutrality, could be designed to challenge political views from the opposing side during dialogue: "*Basically it could be programmed so that, no matter what your opinion is, whether you are far right or far left, it always challenges you from the opposing side (..) It knows how to disagree and challenges you to think"* (U3).

4.1.4 Facilitating Discussions About Civics

University group U3 ideated an intelligent home robot to take over various domestic tasks (R6), but also considered additional benefits such a robot could provide. It was suggested that robots could potentially initiate or facilitate conversations in the home environment: "*The robot could sometimes casually try to talk about these kinds of societal topics"* (U3). The group also proposed that during conversations, a home robot could passively gather data about younger family members' views on the world, and this data, according to group U3, could be further used for national research projects to increase understanding on children's worldviews. University group U1 also mentioned social robots as potential conversation stimulators for younger people but did not elaborate on the idea.

The library assistant robot (Fig. 4), concepted by group U2, is a service robot whose primary task is to help customers by finding or suggesting books based on their requests. The robot is equipped with conversational skills and has access to recent news about world events, which it can use to engage in discussions if desired. The group suggested that the robot could potentially attract younger people to spend more time in the library, and it could even become a regular conversational partner for some youth.

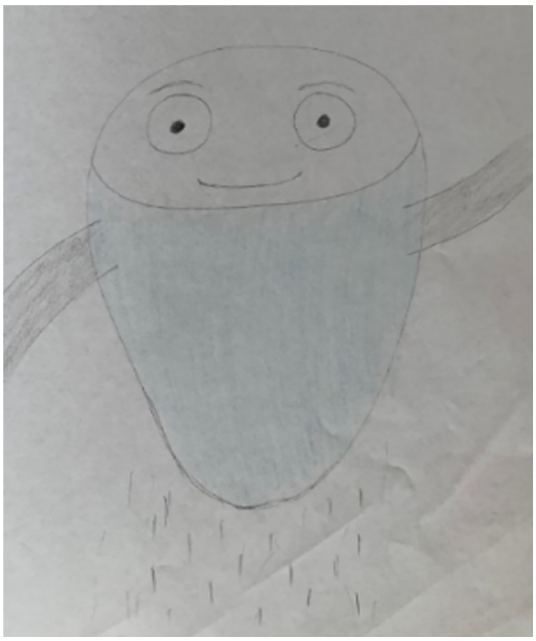

Fig. 4 The library robot (R4) named "Sam" is smoothly shaped, hovers over surfaces, and adjusts its height according to customers

The same group (U2) suggested that a robot could assist people in voting locations (R5), but in this scenario, the robot was primarily seen as an attractor to increase voter turnout. The group noted that while novelty might be useful for sparking short-term curiosity, such technologies would eventually become ordinary, which could represent a dilemma for sustainable designs.

4.2 Environmental Actions

The second theme focuses on environmentally friendly habits and consumption choices. These ideas propose solutions to help individuals reduce their carbon footprint by guiding them in making ecological decisions and making the impact of their actions more transparent.

4.2.1 Assisting in Decision-Making

Groups U1, U3 and H9 suggested that robots could provide informative services to promote more sustainable behavior in society. A robot was envisioned as a product advisor informing customers about food options in a grocery store (R8): *"You could go talk to it and it could tell, for example, what is the effect of choosing organic meat versus normal meat, what is the concrete impact between them"* (U3). In a food cantina, a robot could display statistical and comparative data on recent food waste (R1). It could also illustrate the impact of carbon footprints by comparing food waste data to gasoline consumption, for example. At home, a robot could suggest the most sustainable traveling routes (R6): *"[It says that] a bus would take five minutes longer [than driving a car], but you could do something else during that time"* (U3). A robot-refrigerator could track a person's eating habits and express concern when those habits appear unhealthy or unsustainable: *"Eating and healthy diet is probably important, so this guides people toward a green, ecological diet"* (H1). Finally, recycling guidance robots (R1, R12, R16, R23) were proposed based on the assumption that robots could help identify objects and guide people on how to recycle correctly: *"Some things are not so obvious, for example, what is mixed waste and what is plastic waste (…) you could ask it where to put the item"* (U1).

4.2.2 Encouraging Environmental Actions

While the previously mentioned information-related aspects were considered interesting persuasive elements for a robot, its potential social and emotional aspects were also taken into account. For example, the robot-refrigerator could be equipped with digital eyes that convey emotions when expressing concern, and the cantina robot could give cheerful feedback: *"When you don't throw biowaste into mixed trash it's like 'great', some smile or something, thumbs up"* (U1). For the university group U1, it was important that the robot's appearance and behavior evoke empathy so that people would not want to disappoint the robot by acting against its instructions. However, as these recycling concepts were designed for public environments, they also included an element of social pressure, mainly due to the feeling of being observed: *"When you take food to the [wrong] trash, if there is a person there looking at you, you may not do it. The robot would also cause that a little bit. It is kind of discouragement"* (U1). The group U1 emphasized that the robot should not accuse people but instead be kind and encouraging to avoid putting people on the spot. In comparison, a high school group envisioned a cleaning robot that would more explicitly enforce recycling: *"It tells you if you recycle wrong or put something in the wrong container"* (H2). The group H2 also mentioned that hearing certain repetitive reminders about recycling from a robot would be more tolerable than hearing such things from a person, especially a close one: *"You could tolerate [the robot's] nagging if you set it to use a pleasant voice for it."*

Intelligent refrigerator (R9, Fig. 5), ideated by high school students, gathers data about a person's eating habits to guide them toward ecological, plant-based diet. Should a person temporarily fall into unhealthy eating habits, the robot expresses concern through its eyes to remind them of the importance of healthy food. Part refrigerator, part chef, the robot makes everyday life more efficient by creating meals from available ingredients or assisting with cooking. It also provides companionship for those who are lonely and shares news.

Fig. 5 The intelligent refrigerator (R9) design, sculpted with silk clay. The robot expresses emotions through its eyes

4.3 Social Inclusion

The third theme concerns preventing alienation and exclusion from society by supporting individuals in managing everyday affairs and life in society. In these concepts, societal participation is not seen as active involvement (as in the previous themes) but rather as a person's ability to manage their own affairs and become familiar with societal practices.

4.3.1 Bridging Language Barriers

Two high school groups (H5 and H6) ideated a robot primarily for the purpose of translating speech in real-time, either in educational settings or during social interactions. Both concepts were developed based on the needs of immigrants participating in education who struggle with language barriers. Group H5 wrote on their canvas: *"[The robot] guarantees equal opportunities in education, and thus supports youth's societal participation, because they would have access to better education and language learning.*" These concepts stand out in the data because they focus on a specific subgroup of youth, mainly immigrants and exchange students, identifying their needs and illustrating how a social robot could potentially address them. Unfortunately, the interaction between participants in workshop 4 was limited due to the challenges of the new online format, and the concepts lack further detail. Additionally, the concepts do not clearly justify why an embodied robot is necessary for the task, leaving it unclear whether the participants were designing a robot or a device.

4.3.2 Teaching Life Skills

University group U4 ideated a robot to teach young people about finances, while U5 ideated a robot to teach various life skills. Both share the idea that social robots could illustrate and teach everyday matters in an interesting way. The everyday skills teacher (R17) is an owl-shaped robot, nicknamed by the group as "Knowl", that helps young people understand practical tasks related to household management or bureaucratic matters, such as applying for social services. The idea stemmed from the challenges young people face when they start living independently: *"Because there are a lot of things that you never had to do before you moved out of the house, so you don't know these things"* (U5). University group U4 ideated a somewhat similar concept, but with a focus on financial matters: "*For example, it can guide about money issues and investment, paying taxes and so on."* The group felt that such topics should be taught by civics classes at school, but they might seem more approachable and interesting if communicated through a robot. This idea is further detailed below.

The Buddy robot (R15, Fig. 6) is designed to support youth in life management, for example, by instructing them how to use weekly allowance or invest within a certain timeframe to reach specific goals. Users can input data into the robot, which then produces personalized tips. The robot helps young people manage their financial affairs, make sustainable choices, and gain general knowledge important for navigating society. Additionally, the robot should deliver this information in an entertaining way: *"Feels like financial matters are serious, so if it could somehow make it more interesting, translate it to 'youth's language' in some funny way."* The robot can also adopt different interaction styles based on the user, offering a personalized experience. The group emphasized that the robot should be designed to be approachable, with easy-to-initiate interactions that are, most importantly, optional. Careful consideration should be given to where the robot is located, as interacting with it requires privacy.

Fig. 6 The "Buddy" (translated from Finnish word "Kamu") (R15). The writing on the top left corner reads "the model is built from a used vacuum cleaner"

4.4 Well-Being

The ideas grouped under the fourth and final theme concern mental and social support applications for robots. While these ideas are less directly connected to the intended scope of the workshop, they highlight use scenarios for social robots that may still be relevant for youth.

4.4.1 Providing Supportive Interactions

University group U1 suggested that robots could be ideal listeners to whom people can freely "rant" their emotions (R3): *"There could be one here at school, so that you can complain about all those school things that are unfinished and when you are annoyed and so on, in one of those chat booths there would be a robot that would listen when you want to open up to it"* (U1). Rather than providing helpful suggestions and appearing to truly understand the issues, it was considered sufficient if the robot responded with a gesture: *"It would be important that it has some ability to react to what is said"* (U1). A similar suggestion was made by the university group U4: *"Could there be, at a secondary school, some kind of a robot that listens to worries. That would need a more private/closed off location, but it could be like a support figure"* (U5). High school group H8 ideated a conversational therapeutic robot for teens that could help with bullying or handling traumatic experiences: *"It talks with the person and gives options and possibilities"* (H8). Group H2 also suggested that robots could help people who are bullied: *"To prevent bullying, we could put a robot at a school"* (H2). However, a participant in H2 deemed the idea problematic: *"The one who goes to talk to that robot will be bullied even more."*

Apart from these therapeutic interactions, social robots could be utilized to support people in socializing with each other. Group H1 suggested that social robots could help young people initiate conversations and get to know each other through activities: *"I had this idea, I don't know if it's suitable for this but an icebreaking robot. You know, getting to know people."* The robot could make initiating interactions easier and could be useful for young people who struggle with forming social connections: "*Because people get to know each other best when they do something"* (H1). Overall, the robot ideas produced in this category focused on supporting social interactions between people, which may reflect underlying issues related to social anxiety, a common concern among youth, through social anxiety was not explicitly mentioned in conversations or canvases.

4.4.2 Automating Laborious Tasks

Several groups mentioned that robots would be ideal for taking over various types of labor in society and at home. For example, if robots handle cleaning at home, time could be dedicated to other activities (U3, H2): *"Then you have more time for studies and school, your work, eating, sleeping, playing"* (H2). At home, robot could cook for (or with) a person, making daily life more efficient (R9). While automation was seen as a positive development that could enhance the quality of life, participants briefly noted that automating certain tasks could lead to job losses, raising some concerns. However, university group U1 argued that certain jobs are worth automating so that people would "*get to pursue more stimulating work"* (U1) which could improve their well-being.

5 Discussion

In this exploratory study, we engaged high school and university students (n = 47) in five design workshops to ideate and design social robots that could support young people's societal participation in the domains of sustainable development. Our main research question was: *What forms of societal participation are addressed in social robot concepts designed by young people?* In the resulting 24 robot ideas, we identified four broad themes related to societal participation: democracy, environmental actions, social inclusion, and well-being. Although the themes represent young people's ideas about suitable contexts and purposes for robots, we note that these broad themes are relevant to other age groups as well. In this discussion, we first summarize the forms and contexts of

societal participation addressed in the ideas and discuss the potential strengths of social robots in these roles. Additionally, we consider how the concept of sustainable development was addressed by participants and how sustainability was reflected in the robot ideas. Based on our findings and prior research on the potential advantages of robots, we examine what characterizes a robot as a civic robot and outline four possible interaction roles for civic robots. Finally, we reflect on lessons learned, consider the study's limitations, and suggest next steps.

5.1 Forms of Societal Participation Addressed in Youth's Robot Ideas

Only few robot ideas produced in the workshops were directly related to traditional, formal types of civic participation, which supports the notion that young people lean towards informal modes of societal participation [31]. Alternatively, it is possible that most participants did not perceive value in introducing robots into the context of formal civic participation. Nevertheless, one idea (R2) portrayed robots as *intermediaries between citizens and decision-makers*. This role relates to closing the distance between people and decision-makers, a common purpose of civic technologies [55]. Compared to human intermediaries, robots' neutrality was seen as a strength, especially in situations where a person would be giving negative feedback. Additionally, placing intermediary robots in commonly frequented places was considered likely to reduce the effort of participation and increase interest in it. Thus, one potential context for civic robots could be raising citizens' interest in sharing their views about local issues, especially for those unlikely to participate through other means, thereby making participation more accessible. Young people's need to be heard through other than official participation channels [31] could potentially be addressed with such intermediary robots.

Another informal form of participation mentioned in the ideas was discussion. Sharing and articulating one's ideas with other members of society, whether through casual conversation with friends or more formal means, is a form of societal participation [33]. Some workshop groups considered encouraging active engagement in such discussions as a potential use for social robots. For this purpose, the robot's conversational skills and access to information were highlighted as strengths. For example, the conversational home assistant (R6) would persuade individuals to share their views on current events, thereby fostering discussions within the home environment. Based on these ideas, we suggest that the role of social robots as *conversation stimulators* could be further explored. For instance, as icebreakers [56], social robots could introduce topics or problems around specific issues. However, the design must carefully consider how to initiate and facilitate discussions in a socially comfortable manner, as well as determine the appropriate contexts for such interactions. Additionally, it is essential to establish clear ethical guidelines for such applications, particularly when addressing controversial topics.

Education, in general, was a commonly envisioned context for social robots, which is unsurprising given that all workshop participants were students. Many groups brainstormed ideas for robots that could provide education in a friendly and personalized way (R4, R13, R15, R17, R21, R23). Robots were envisioned as more engaging communicators than people or screens, capable of delivering more personalized teaching, aligning with prior research on the benefits of social robots in education [19]. Some participants suggested that social robots could offer alternative and enjoyable ways to present even serious information, which might otherwise be perceived as dull in a traditional classroom setting. One opportune context for civic robots could hence be in civics education, as such education can broadly strengthen youth participation and involvement in society [8]. Civics teacher (R21) was conceived as a broad solution to address knowledge gaps and to guide young people toward forms of participation that best suit their individual interests. Moreover, some participants (H7, U4) felt that youth are still learning about democratic society and may lack an understanding of the practical aspects of formal participation (e.g., organizations, unions, political parties) as well as their own opportunities to take action (cf. [8]). We suggest that more detailed use scenarios for *civic educator robots* could be generated through research and co-design practices, ideally focusing on the unique ways that social robots could support civics and citizenship education both within and outside the classroom, including personalized teaching and neutrality. Robots were seen as neutral and unbiased communicators, making them capable of more objectively presenting the ideological implications of politicians and parties. Robots were envisioned as communication partners capable of exposing diverse perspectives and presenting counterarguments through dialogue (R7). Based on these observations, we propose that the perceived neutrality of robots could be a strength in the context of learning about political communication and participation. Exposure to conflicting preferences can be cognitively stimulating and may increase interest in politics [57].

Consuming media such as television, newspapers, and the internet generally increases civic knowledge, which can subsequently increase participation [30]. In the workshops, *increasing awareness* about current world issues was envisioned as a potential role for a social robot. For example, the library robot (R4) would provide information on both global events and local happenings, while the intelligent refrigerator (R9) could share news updates. It was also envisioned that the home robot (R6) could expose young people to world events by occasionally turning on the television news. In these concepts, raising awareness was seen as a secondary task for the

robot, complementing its primary, more practical functions. This suggests that providing information alone may not be enough to justify the use of an embodied robot. Instead, a robot designed for a practical purpose could offer information on current societal issues as an added benefit.

A few groups also viewed robots as machines capable of providing social interaction experiences or even social support, which could positively impact well-being. Robots were seen as capable of offering unbiased social support—interactions free from judgment—which could be particularly beneficial for youth suffering from social anxiety or those who have experienced belittling or discriminatory treatment in interactions with others. This perception of non-judgmental robots somewhat aligns with findings from the EMAR study, where youth expressed interest in having a robot as a conversation partner to talk about stress [24]. Furthermore, the Rantbot (R3) was envisioned as an application for individuals needing an outlet to express negative emotions. Although participants did not explicitly connect these social support ideas to societal participation, we can relate them to some extent to young people's need to be heard and taken seriously [31]. Social robots could therefore be explored as *therapeutic tools* to simulate and practice anxiety-inducing situations, such as public speaking and argumentation, allowing individuals to receive positive reinforcement from a robot in a safe environment. In other words, robots designed as civic educators or to stimulate civic discourse could also be studied for their therapeutic potential, particularly for those who wish to participate in discussions but experience social anxiety, as also suggested by Rasouli et al. [58].

5.2 Sustainability Domains in the Robot Ideas

The concept of sustainability was proposed to the workshop participants to guide their ideas about societal participation, encouraging them to address the broad sustainable development goals, including environmental, social, and cultural sustainability. Many groups associated sustainability primarily with environmental issues, leading to several ideas for recycling robots (R1, R12, R16, R23). Recycling is a common and relatively manageable form of everyday participation for youth [31]. Recycling assistance was seen as an appropriate and easily understandable use case for robots, and they were generally envisioned as useful for all age groups. Robots were also proposed as assistants for reducing one's carbon footprint, particularly in areas such as purchase decisions, dietary choices, and travel options. Consumption choices represent a form of societal participation, as individuals can make decisions about which products to support or boycott [33]. The robot ideas highlight that making sustainable choices in society can be challenging without access to information about the available options and impact of specific actions. Therefore, robots could play a role in *raising awareness* about environmental sustainability. Unlike mobile phones or similar devices, robots were envisioned as technologies integrated into environments, where encounters with them would be more spontaneous and, therefore, more likely to influence people. It was suggested that robots could make serious things fun or turn ordinary activities like recycling into more exciting experiences. These use cases are supported by prior research, which has shown that a robot's physical embodiment can provide more engaging and persuasive interactions over screens [59–61].

However, the role of the robot in promoting sustainable actions needs further clarification. Some participants suggested that if robots could use emotional expressions to evoke empathy, people might be more inclined to act sustainably. Research on social robots promoting sustainable behavior indicates that social feedback may be more effective than factual feedback [62]. While persuading individuals to adopt sustainable behaviors presents a promising opportunity for social robots in general, we believe this approach may be problematic for civic robots, as it could undermine people's agency and ability to make independent choices. Instead of directly imposing behaviors and values—as seen in some of the workshop robot concepts—civic robots should be designed to support individuals in making informed decisions and takin action towards the goals they already value and seek to act upon. Similarly, the *conversation stimulator* robot concepts related to civic discussions emphasized that while robots could stimulate dialogue and present neutral or opposing viewpoints, they should not appear to hold or promote specific ideologies. Instead, the goal of such robots should be to simply illustrate the diversity of political ideologies and methods of persuasion. This would preserve the neutrality and objectivity that participants identified as a unique strength of robots.

Several groups addressed issues related to social and cultural sustainability, as reflected in the social inclusion theme in our findings. In two high school workshops, a robot was envisioned as functioning as a translator to reduce language barriers between people (R19, R20). Additional robot concepts included robots designed to facilitate social interaction between people who speak different native languages (R20) or to make classroom education more accessible for immigrant populations (R19). However, the groups did not address the specific benefits of using a physically embodied robot in these contexts. Nevertheless, the groups recognized language as a potential barrier for certain populations to participate in society and feel socially included in their everyday environments. In previous research, social robots have been studied in the context of foreign language teaching for preschool children; however, due to technological limitations of current robots, their educational benefits remain somewhat unclear

[63]. However, supporting the communication needs of specific subgroups could be aided by social robotics: Homburg et al. [64] report the design of a robotic humanoid hand that translates speech into sign language, facilitating the inclusion of deaf individuals. Moreover, beyond civics education, some workshop groups proposed robots for teaching skills that promote societal inclusion. The ideas focused on enhancing financial literacy (R15) and providing access to useful, practical information about everyday matters (R17), which could be illustrated or practiced through a robot's interface. Such robots were envisioned as potentially helpful for youth who need information about societal processes but may not have a supportive adult figure in their lives. This purpose aligns with goals of social sustainability and reducing inequalities.

5.3 Potential Interaction Roles for Civic Robots

We use our findings and prior research as material to discuss what could characterize robots as civic robots and to determine their potential roles in supporting societal participation. To recap the workshop findings, young people envisioned robots that could support both formal and informal participation in democracy, as well as assist with the basic skills needed to manage daily affairs in society as citizens. The ideas focused on civic participation highlighted the importance of knowledge and skills required to participate in society, particularly making democratic practices understandable to youth and providing more opportunities for participation. The ideas centered on social inclusion emphasized the need for information to make informed decisions and the importance of essential skills, such as financial literacy. While some ideas, such as school-based robots and skills teachers, were primarily oriented towards youth, most of the robot concepts could be applicable to other age groups as well. Based on the identified contexts and purposes, we propose that civic robots can be characterized as follows:

> *Civic robots are designed to ease, increase, or support individuals' active democratic participation, citizenship education, or social inclusion. Civic robots can support participation in specific situational contexts or help develop people's abilities for participation in educational settings. Civic robots may function as information sources, conversational agents to foster societal discourse, or mediators between citizens and other societal actors.*

In our findings, a perceived advantage of robots over humans was that they were imagined to be socially neutral information sources or agents (i.e., without a personal stake or emotional stance on issues), allowing for interactions distinct from those with humans. This suggests that, as agents, civic robots should demonstrate objectivity and neutrality regarding worldviews or political ideas. Their role should be limited to objectively presenting various perspectives and illustrate options, without directly persuading individuals toward a specific choice. For example, in the context of local elections, the optimal role for robots could be to encourage individuals to visit the voting site and provide relevant information about the options, without promoting specific candidates. Similarly, while persuading individuals to adopt more sustainable behaviors could be seen as a well-intentioned goal aimed at the future well-being of the planet, such robots may not qualify as civic robots if behavior change results from social pressure (a concern raised by some participants) or other persuasive influences.

Based on the workshop findings and the current discussion, we identified four potential interaction roles for civic robots by evaluating which roles could be justified for a robot (compared to humans or other technologies) and where prior research suggests that a robot could provide value as an embodied and locally situated technology. The roles are outlined in Fig. 7 and described below.

1. *Informing* The most generic and versatile role for a civic robot is to serve as an information source (cf. *increasing awareness*), accessible for various needs across various locations and settings, including public spaces and educational environments. A robot designed to inform could engage people in an entertaining manner to learn about society, convey local or global news, describe or suggest local activities and participation opportunities, or present data and provide personalized recommendations. The primary aim of designing an informative robot is to offer citizens an alternative way to access information that could facilitate societal participation. Robots may have advantages over other devices or humans due to their potential for higher engagement and perceived neutrality. Research has shown that social robots can be more engaging than tablets at delivering information [59]; therefore, robots in this role could be designed to spark curiosity and thus increase information reception.
2. *Stimulating* A robot could be designed to encourage or increase societal discourse among people (cf. *conversation stimulators*). This could be achieved actively by introducing topics or interjecting statements that prompt responses or discussion in social settings. Alternatively, the mere presence of the robot might serve as a conversation starter. LeTendre and Gray [65] found that the social robot Pepper, when used in a classroom setting, stimulated students' thinking about robot sociality. In the Robot Activist study [22], a social robot was used as a pedagogical agent to both inform and stimulate, with the findings suggesting that such a civic educator robot could reduce the burden on educators and make learning more enjoyable for students, potentially having a positive impact on learning outcomes [22].

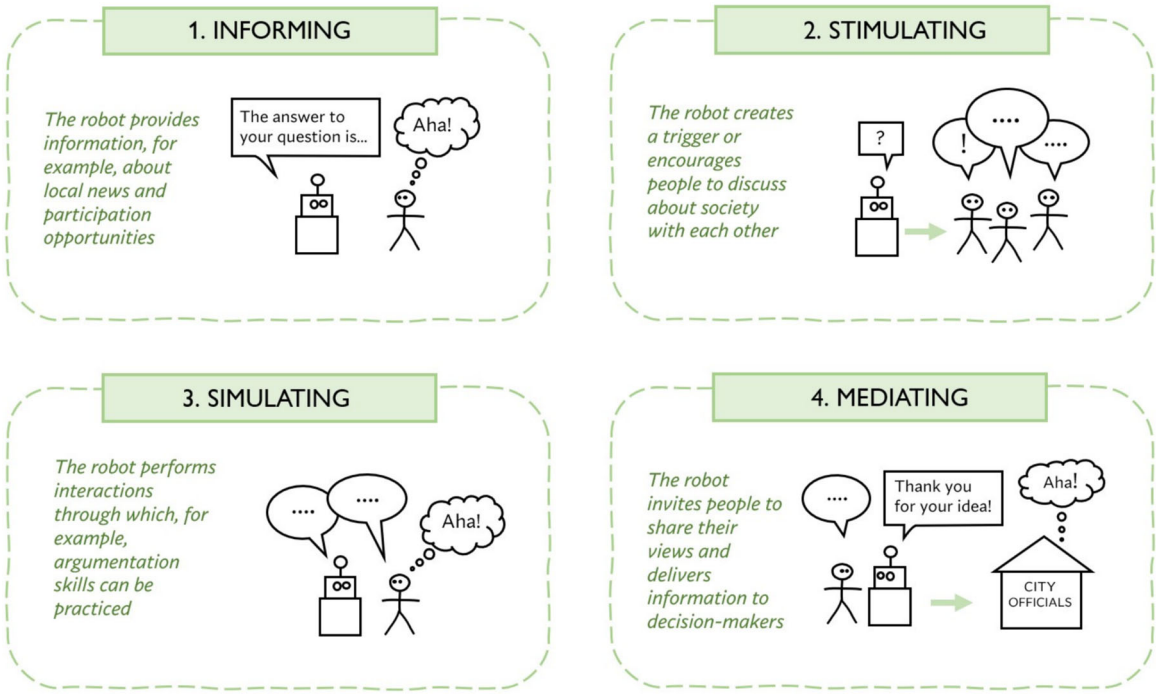

Fig. 7 Proposed interaction roles for civic robots

3. *Simulating* A robot can be designed to mimic human social interaction, to theatrically illustrate or *simulate* aspects of societal discourse to promote learning. Social robots could be used to enact conflicting viewpoints or demonstrate potential consequences in political discussions. In civics education, simulation games have been utilized as an engaging teaching method, promoting the acquisition of skills over textbook information (e.g., [66]). Embodied interactions with a robot could offer enhanced engagement or alternative opportunities for simulation exercises. Additionally, if social robots are experienced as non-judgmental compared to humans as interaction partners (cf. [49]), such simulations could have potential benefits for people that experience social anxiety [67].
4. *Mediating* As an *intermediary between citizens and decision-makers*, a robot can serve the purpose of receiving and collecting information from citizens by encouraging them to share their opinions on local issues. The robot acts as a physical, embodied medium with which people can interact (cf. [68]) to convey feedback, serving as a tangible representation of the decision-maker who is not present in the location. Mediating through a robot could have an advantage over screens or apps, as a robot's physical presence could invite spontaneous interactions among people [21] thereby enhancing participation. However, the robot's role in the environment would need to be clearly communicated to the public, as individuals may initially struggle to understand what the robot's presence entails (e.g., [69]).

The four interaction roles can serve as inspiration for researchers and designers to further explore whether social robots could provide value in civic contexts, while critically examining the potential costs and benefits of robotic technology for a given problem. The roles can also be combined with or contrasted against social roles identified in prior research and the contextual themes presented in our findings. For example, in the education domain, social robots have been placed in roles of tutor, peer, and novice, depending on how they are utilized in teaching [17]. In civics education, a robot could be designed by combining the roles 1–3 listed above to function, e.g., as a tutor informing about societal matters and simulating discussions or debates (cf. Democracy theme), and as a peer stimulating conversation among students (cf. Social inclusion theme). While we have discussed the interaction roles primarily in the context of societal participation, they are not necessarily limited to this context and can be applied in other situations where the purpose of the robot is to support and maintain engagement with humans.

5.4 Lessons Learned About the Design Procedure

Our design workshops successfully generated a variety of ideas and themes related to supporting young people's societal participation through social robots, but the workshop

structure and the topic introduced certain constraints and challenges for the participants. Although the participants produced interesting design concepts, the various dimensions (social robotics, societal participation, sustainability) within the workshop setup constituted a rather complex scope that may have been difficult to address in the brief timeframe of the sessions. The workshops were also limited in terms of the introduction and discussion around the concepts of youth participation and sustainable development, which may have led to variations in how participants understood the topics. Moreover, some groups struggled to integrate the concepts of sustainability and societal participation into a single idea, opting to focus on one or the other instead. Some groups expressed uncertainty about how to choose the most appropriate concept from the ideas presented. Several civics-related ideas were included and discussed during the initial ideation session, but the groups abandoned these in favor of more traditional robot concepts. Additional feedback and discussion with facilitators at this stage of the process would have been helpful to guide the design process toward the workshop's goals.

During our analysis and review of the workshop discussions, we observed that participants occasionally engaged in discussions where the capabilities of robots were envisioned based on what could be possible for robotics in the future. In some discussions, the descriptions of robotics in society resembled a technocentric approach, portraying technology linearly "fixing" social problems [70]. On the other hand, some participants discussed appropriate and acceptable behaviors for robots, considering social and societal contexts. They often discussed what the robot should *not* be like, typically from humorous or sarcastic perspectives. Some participants also identified specific dilemmas in their design ideas, such as the cost–benefit ratio of using a robot for a particular task in society. However, the design canvases did not explicitly prompt participants to record these important considerations. In the future, robot design canvases could also encourage reflection on the critical or problematic aspects of the design. Furthermore, the design process could more explicitly incorporate value-based considerations, following the approach suggested by integrative social robotics [71], such as by treating values as experience goals in the design process [25]. Participants should also be explicitly guided to evaluate the benefits and limitations of robots as technologies within their concepts and provide clearer justifications for using a social robot as the solution by comparing them to other technologies (or non-technologies).

Participants envisioned human–robot interactions occurring either with one individual or a group of people. However, they only briefly considered the possibility of spectators in the use scenarios, or whether the environment where the interaction takes place is open to public or physically isolated. It was noted that certain tasks may be challenging to perform with a robot when others are present; for instance, creating a financial plan with a robot would require privacy. Uncertainty about one's knowledge or skills is a common barrier to participation for young people [8], and the presence of others may exacerbate this. To address this, the robot design process should explicitly require specifying the social environment in which the robot will be placed and how interactions in that setting would naturally unfold. Specifically, it should consider whether the environment is open to potential spectators or physically isolated, and how the presence of other participants or spectators might influence the interaction (cf. [72]).

We observed that the role of the robot operator was absent from the discussions. Robots were envisioned as independent actors or agents within an environment, rather than as tools that could be used in specific settings that involve human actors. The exception was the teacher's assistant, which was considered operating alongside a teacher. However, even in this case the robot was proposed to be used by a particular student or group of students when the teacher is not available. It is possible that the workshop introduction influenced participants to view robots as independently operating systems or agents without a human operator. Additionally, existence of simultaneous multiple robots was not considered in the workshops, likely because the guidelines focused on designing a single robot. In future work, the role of the operator and the possibility of multiple robots co-operating could be included in the canvas instructions.

Despite the shortcomings discussed above, we observed that the workshop's framing successfully guided participants to discuss the practical implications of societal participation and sustainable development. Through the design process, participants expressed what is termed in the context of Research through Design as an 'ideal state' of the world and envisioned how this particular technology could transform the current state to the ideal one. The workshops seemed to function as exercises in which participants attempted to identify and solve societal problems, and in doing so, enacted societal participation within the actual workshop situation. Additionally, the discussions reflected both visions and concerns regarding the development of technology. Thus, we learned that engaging youth in the design process itself can be seen a way to increase their societal participation and empower them as citizens, as also suggested by [73] in the context of digital game design for social issues and by [42] in the context of political messaging.

5.5 Limitations

While the findings from the workshops reflect diverse ideas, they were conducted in a high-income democratic country, and the resulting ideas should be interpreted within that context. It is also worth noting that the gender ratio in the physical

workshops was more skewed than in the online workshops, and we cannot determine to what extent this influenced the resulting designs. Furthermore, university participants and high school participants appeared to approach the design task from somewhat different perspectives. The university participants did not seem to identify as the target users, instead referring to the target users as "them" and empathizing with "their" needs. High school participants likely viewed themselves as the target users, as evidenced by some reflections and opinions expressed about the designs. However, some university groups did reflect on their own experiences transitioning into adulthood and shared unique insights about what information could be valuable for young people to learn. Therefore, while university participants may not have designed the robots for themselves—perhaps because they no longer perceived themselves as 'youth'—they demonstrated thoughtful consideration of the target age group's potential needs and preferences.

The level of engagement in the workshop activities varied somewhat among participants. University groups in both online and face-to-face modes (W1, W3) were more proactive and talkative, exploring possible scenarios in more detail. In contrast, some high school groups were less talkative, with some participants showing signs of being unfocused or disinterested in the task. It is possible that high school participants approached the design task as a school assignment. Quantitative feedback ratings from the online workshops (reported in [74]) suggest that, while the overall workshop experience was rated positively, high school students found the workshops somewhat less meaningful than university students, which may be reflected in the ideas and concepts they produced. Additionally, the group-based workshop setup may not have been inclusive to some high school participants, particularly those who experienced social anxiety. The face-to-face sessions were noisy due to simultaneous group discussions, which is not ideal for participants with sensory sensitivities.

In the online mode, it was challenging for facilitators to engage high school groups in the design task, and the facilitator's role in the conversation was more prominent than in face-to-face workshops (detailed in [74]). School education had recently transitioned to online mode due to COVID-19, and it may still have been an unfamiliar or less preferred way of working for adolescents. The warmup time before the design process was very short, likely affecting group formation and limiting the extent to which participants shared their ideas.

6 Conclusion

Through five design workshops with young people, we identified potential contexts and roles for social robots to support societal participation, structured under four themes: democracy, environmental actions, social inclusion, and well-being. The workshops produced robot concepts designed to support young people's formal and informal participation in democracy and help them develop the basic skills needed to manage daily affairs as independent citizens. In addressing the barriers to participation faced by young people, the findings highlighted the importance of knowledge and skills to participate in society, emphasizing the need to make democratic practices understandable to youth, assist in decision-making, and foster independence. Young people envisioned robots as neutral and nonjudgemental agents, enabling interactions distinct from those with humans. Also, robots, as physically embodied entities, could afford spontaneous and socially engaging encounters, offering a different experience compared to screens and personal devices such as mobile phones.

Our findings suggest several potential civic robot concepts, including robots as conversation stimulators, civic educators, intermediaries between citizens and decision-makers, means to increase awareness, or therapeutic tools. As a broad framework for civic robot design, we have determined four potential interaction roles that appeared feasible for youth and potentially applicable to other age groups as well: informing, stimulating, simulating, and mediating. These roles can be combined with the identified contexts in future research and design activities. Since this was an exploratory design study mapping the potential of social robots in the civics domain, we cannot draw a conclusion that robots could meaningfully support societal participation in the real world, as the benefits of such interactions in actual situations cannot be assessed based on the present study. The potential benefits and more detailed use cases could be further investigated in design research and empirical studies with actual robots. The proposed broad interaction roles, along with the specific concepts and contexts, can serve as inspiration and provide a framework for further research on civic robots, involving more diverse demographics and cultures, to determine if and where civic robots could truly have an impact on promoting more equal and inclusive societal participation.

Acknowledgements The research was funded by the Academy of Finland Project RoboCivics with decision no. 321839. We thank Elina Hildén for designing and preparing the canvases used in the face-to-face workshops and facilitating the first two workshops, and we thank Nancy Nilsson for participating in facilitating the online workshops. We also warmly thank the study participants and the teachers who invited their students to participate.

Author Contributions All authors contributed to the study design. Data collection was conducted by KK, AA, SJ and JV. The analysis was primarily performed by SJ, with assistance from KK during the early stages. KK, AA, JV and KV provided feedback on the analysis findings and their presentation. Manuscript was drafted by SJ and KK. SJ wrote the final manuscript, except for the methodology section, which

was mostly written by KK. All authors read and approved the final manuscript.

Funding Open access funding provided by Tampere University (including Tampere University Hospital).

Data Availability The data generated during the study will be available from the corresponding author upon a reasonable request.

Declarations

Conflict of interest The authors have no relevant financial or non-financial interests to disclose.

Human and Animal Rights The study was performed in accordance with the ethical principles of research with human participants defined by the Finnish National Board on Research Integrity. Participation was voluntary. Informed consent was obtained from all individual participants included in the study. All participants were over 15 years old and thus able to sign informed consent.

Informed Consent Informed consent for the data collection and publishing the findings in a research article were obtained from all individual participants of the study.

References

1. Parvin P (2018) Democracy without participation: a new politics for a disengaged era. Res Publ 24:31–52. https://doi.org/10.1007/s11158-017-9382-1
2. Abbott S (2010) Social capital and health: the role of participation. Soc Theory Health 8:51–65. https://doi.org/10.1057/sth.2009.19
3. Pietilä I, Meriläinen N, Varsaluoma J, Väänänen K (2021) Understanding youths' needs for digital societal participation: towards an inclusive Virtual Council. Behav Inf Technol 40:483–496. https://doi.org/10.1080/0144929X.2021.1912182
4. United Nations (2018) World Youth Report: Youth and the 2030 Agenda for Sustainable Development. New York
5. Checkoway B, Aldana A (2013) Four forms of youth civic engagement for diverse democracy. Child Youth Serv Rev 35:1894–1899. https://doi.org/10.1016/j.childyouth.2013.09.005
6. Karsgaard C, Davidson D (2021) Must we wait for youth to speak out before we listen? International youth perspectives and climate change education. Educ Rev 75:74–92. https://doi.org/10.1080/00131911.2021.1905611
7. Boulianne S, Ohme J (2022) Pathways to environmental activism in four countries: social media, environmental concern, and political efficacy. J Youth Stud 25:771–792. https://doi.org/10.1080/13676261.2021.2011845
8. Checkoway B (2011) What is youth participation? Child Youth Serv Rev 33:340–345. https://doi.org/10.1016/j.childyouth.2010.09.017
9. Pietilä I, Varsaluoma J, Väänänen K (2019) Understanding the digital and non-digital participation by the gaming youth. In: Lamas D, Loizides F, Nacke L et al (eds) Human-computer interaction—INTERACT 2019. Springer, Cham, pp 453–471
10. Cho A, Byrne J, Pelter Z (2020) Digital civic engagement by young people. UNICEF Office of Global Insight and Policy
11. Kaipainen K, Jarske S, Varsaluoma J, Väänänen K (2020) Persuading youth in civic participation with social robots: What is appropriate? Cult Sustain Soc Robot. https://doi.org/10.3233/FAIA200914
12. Sarrica M, Brondi S, Fortunati L (2019) How many facets does a "social robot" have? A review of scientific and popular definitions online. Inf Technol People 33:1–21. https://doi.org/10.1108/ITP-04-2018-0203
13. Deng E, Mutlu B, Mataric MJ (2019) Embodiment in socially interactive robots. ROB 7:251–356. https://doi.org/10.1561/2300000056
14. Petersen S, Houston S, Qin H et al (2017) The utilization of robotic pets in dementia care. J Alzheimer's Dis 55:569–574. https://doi.org/10.3233/JAD-160703
15. Salimi Z, Jenabi E, Bashirian S (2021) Are social robots ready yet to be used in care and therapy of autism spectrum disorder: a systematic review of randomized controlled trials. Neurosci Biobehav Rev 129:1–16. https://doi.org/10.1016/j.neubiorev.2021.04.009
16. Guemghar I, de Oliveira P, Padilha P, Abdel-Baki A et al (2022) Social robot interventions in mental health care and their outcomes, barriers, and facilitators: scoping review. JMIR Ment Health 9:e36094. https://doi.org/10.2196/36094
17. Belpaeme T, Kennedy J, Ramachandran A et al (2018) Social robots for education: a review. Sci Robot. https://doi.org/10.1126/scirobotics.aat5954
18. Woo H, LeTendre GK, Pham-Shouse T, Xiong Y (2021) The use of social robots in classrooms: a review of field-based studies. Educ Res Rev 33:100388. https://doi.org/10.1016/j.edurev.2021.100388
19. Barakova E, Väänänen K, Kaipainen K, Markopoulos P (2023) Benefits, challenges and research recommendations for social robots in education and learning: a meta-review. In: Proceedings of the 32nd IEEE international conference on robot and human interactive communication (RO-MAN 2023), Aug 28–31, 2023
20. Sabelli AM, Kanda T (2016) Robovie as a mascot: a qualitative study for long-term presence of robots in a shopping mall. Int J Soc Robot 8:211–221. https://doi.org/10.1007/s12369-015-0332-9
21. Kaipainen K, Ahtinen A, Hiltunen A (2018) Nice surprise, more present than a machine: experiences evoked by a social robot for guidance and edutainment at a city service point. In: Proceedings of the 22nd International academic mindtrek conference. Association for Computing Machinery, New York, pp 163–171
22. Chew E, Khan US, Lee PH (2021) Designing a novel robot activist model for interactive child rights education. Int J Soc Robot 13:1641–1655. https://doi.org/10.1007/s12369-021-00751-3
23. Castellano G, De Carolis B, D'Errico F et al (2021) PeppeRecycle: improving children's attitude toward recycling by playing with a social robot. Int J Soc Robot 13:97–111. https://doi.org/10.1007/s12369-021-00754-0
24. Björling EA, Rose E, Davidson A et al (2020) Can we keep him forever? Teens' engagement and desire for emotional connection with a social robot. Int J Soc Robot 12:65–77. https://doi.org/10.1007/s12369-019-00539-6
25. Kaipainen K, Jarske S, Väänänen K (2023) Identifying opportunities for social robots in youth services: a case study of a youth guidance center. Soc Robots Soc Inst. https://doi.org/10.3233/FAIA220629

26. Väänänen K, Hiltunen A, Varsaluoma J, Pietilä I (2020) CivicBots—chatbots for supporting youth in societal participation. In: Følstad A, Araujo T, Papadopoulos S et al (eds) Chatbot research and design. Springer, Cham, pp 143–157
27. Kaipainen K, Jarske S, Varsaluoma J, Väänänen K (2022) Adolescents' perceptions of the role of social robots in civic participation: an exploratory study. In: 2022 17th ACM/IEEE international conference on human-robot interaction (HRI), pp 826–830
28. Zimmerman J, Forlizzi J, Evenson S (2007) Research through design as a method for interaction design research in HCI. In: Proceedings of the SIGCHI conference on human factors in computing systems. Association for Computing Machinery, New York, pp 493–502
29. Björling EA, Rose E (2019) Participatory research principles in human-centered design: engaging teens in the co-design of a social robot. Multimodal Technol Interact 3:8. https://doi.org/10.3390/mti3010008
30. Schulz W, Fraillon J, Ainley J et al (2016) International civic and citizenship education study: assessment framework
31. Harris A, Wyn J, Younes S (2010) Beyond apathetic or activist youth: 'Ordinary' young people and contemporary forms of participation. Young 18:9–32. https://doi.org/10.1177/110330880901800103
32. Suni A, Mietola R (2021) 'Dear colleagues, I ask you to act like adults': minority youth and their political participation. J Youth Stud. https://doi.org/10.1080/13676261.2021.2009784
33. Hirzalla F, van Zoonen L (2011) Beyond the online/offline divide: how youth's online and offline civic activities converge. Soc Sci Comput Rev 29:481–498. https://doi.org/10.1177/0894439310385538
34. Curato N, Sass J, Ercan SA, Niemeyer S (2022) Deliberative democracy in the age of serial crisis. Int Polit Sci Rev 43:55–66. https://doi.org/10.1177/0192512120941882
35. Alivernini F, Manganelli S (2011) Is there a relationship between openness in classroom discussion and students' knowledge in civic and citizenship education? Procedia Soc Behav Sci 15:3441–3445. https://doi.org/10.1016/j.sbspro.2011.04.315
36. Persson M (2015) Classroom climate and political learning: findings from a Swedish panel study and comparative data. Polit Psychol 36:587–601. https://doi.org/10.1111/pops.12179
37. Claes E, Maurissen L, Havermans N (2017) Let's talk politics: Which individual and classroom compositional characteristics matter in classroom discussions? Young 25:18S-35S. https://doi.org/10.1177/1103308816673264
38. Honkatukia P, Rättilä T (2023) Young people as agents of sustainable society. Taylor & Francis, New York
39. Meriläinen N, Pietilä I, Varsaluoma J (2018) Digital services and youth participation in processes of social change: World Café workshops in Finland
40. Östman J (2012) Information, expression, participation: how involvement in user- generated content relates to democratic engagement among young people. New Media Soc 14:1004–1021. https://doi.org/10.1177/1461444812438212
41. Kahne J, Lee N-J, Feezell JT (2013) The civic and political significance of online participatory cultures among youth transitioning to adulthood. J Inform Technol Polit 10:1–20. https://doi.org/10.1080/19331681.2012.701109
42. Matos S, Ashby S, Hanna J, Rodrigues R (2019) Youth, politics & civic participation: the "Manifesto Machine." In: Proceedings of the 9th international conference on communities & technologies—-transforming communities. Association for Computing Machinery, New York, pp 5–8
43. Literat I, Chang YK, Hsu S-Y (2020) Gamifying fake news: engaging youth in the participatory design of news literacy games. Convergence 26:503–516. https://doi.org/10.1177/1354856520925732
44. Rose EJ, Björling EA (2017) Designing for engagement: using participatory design to develop a social robot to measure teen stress. In: Proceedings of the 35th ACM international conference on the design of communication. Association for Computing Machinery, New York, pp 1–10
45. Costescu CA, David DO (2014) Attitudes toward using social robots in psychotherapy. Erdelyi Pszichologiai Szemle = Transylvanian J Psychol 15:3–20
46. Read JC, Horton M (2016) Future directions for quality TeenCI research. In: Little L, Fitton D, Bell BT, Toth N (eds) Perspectives on HCI research with teenagers. Springer, Cham, pp 269–278
47. Fenech R, Baguant P, Abdelwahed I (2020) Robotics and generation Z—apprehension or attachment. IJBPM 21:245. https://doi.org/10.1504/IJBPM.2020.106110
48. Rose EJ, Björling E, Cakmak M (2019) Participatory design with teens: a social robot design challenge. In: Proceedings of the 18th ACM international conference on interaction design and children. Association for Computing Machinery, New York, pp 604–609
49. Alves-Oliveira P, Björling EA, Wiesmann P et al (2022) Robots for connection: a co-design study with adolescents. In: 2022 31st IEEE international conference on robot and human interactive communication (RO-MAN), pp 578–583
50. Martelaro N, Nneji VC, Ju W, Hinds P (2016) Tell me more designing HRI to encourage more trust, disclosure, and companionship. In: 2016 11th ACM/IEEE international conference on human-robot interaction (HRI), pp 181–188
51. Zimmerman J, Forlizzi J (2014) Research through design in HCI. In: Olson JS, Kellogg WA (eds) Ways of knowing in HCI. Springer, New York, pp 167–189
52. Axelsson M, Oliveira R, Racca M, Kyrki V (2021) Social robot co-design canvases: a participatory design framework. J Hum-Robot Int 11:3:1–3:39. https://doi.org/10.1145/3472225
53. Bartneck C, Forlizzi J (2004) A design-centred framework for social human-robot interaction. In: RO-MAN 2004. 13th IEEE international workshop on robot and human interactive communication (IEEE Catalog No.04TH8759), pp 591–594
54. Mayring P (2000) Qualitative content analysis. Forum qualitative sozialforschung/forum: Qualitative social research. https://doi.org/10.17169/fqs-1.2.1089
55. Corbett E, Le Dantec C (2021) Designing civic technology with trust. In: Proceedings of the 2021 CHI conference on human factors in computing systems. Association for Computing Machinery, New York, pp 1–17
56. Beheshtian N, Kaipainen K, Kähkönen K, Ahtinen A (2020) Color game: a collaborative social robotic game for icebreaking; towards the design of robotic ambiences as part of smart building services. In: Proceedings of the 23rd international conference on academic mindtrek. Association for Computing Machinery, New York, pp 10–19
57. Guidetti M, Cavazza N, Graziani AR (2016) Perceived disagreement and heterogeneity in social networks: distinct effects on political participation. J Soc Psychol 156:222–242. https://doi.org/10.1080/00224545.2015.1095707
58. Rasouli S, Gupta G, Nilsen E, Dautenhahn K (2022) Potential applications of social robots in robot-assisted interventions for social anxiety. Int J Soc Robot 14:1–32. https://doi.org/10.1007/s12369-021-00851-0
59. Li J (2015) The benefit of being physically present: a survey of experimental works comparing copresent robots, telepresent robots and virtual agents. Int J Hum Comput Stud 77:23–37. https://doi.org/10.1016/j.ijhcs.2015.01.001
60. Mann JA, MacDonald BA, Kuo I-H et al (2015) People respond better to robots than computer tablets delivering healthcare instructions. Comput Hum Behav 43:112–117. https://doi.org/10.1016/j.chb.2014.10.029

61. Bainbridge WA, Hart JW, Kim ES, Scassellati B (2011) The benefits of interactions with physically present robots over video-displayed agents. Int J Soc Robot 3:41–52. https://doi.org/10.1007/s12369-010-0082-7
62. Ham J, Midden CJH (2014) A persuasive robot to stimulate energy conservation: the influence of positive and negative social feedback and task similarity on energy-consumption behavior. Int J Soc Robot 6:163–171. https://doi.org/10.1007/s12369-013-0205-z
63. van den Berghe R, Verhagen J, Oudgenoeg-Paz O et al (2019) Social robots for language learning: a review. Rev Educ Res 89:259–295. https://doi.org/10.3102/0034654318821286
64. Homburg D, Thieme MS, Völker J, Stock R (2019) RoboTalk—prototyping a humanoid robot as speech-to-sign language translator
65. LeTendre GK, Gray R (2024) Social robots in a project-based learning environment: adolescent understanding of robot–human interactions. J Comput Assist Learn 40:192–204. https://doi.org/10.1111/jcal.12872
66. Bachen CM, Hernández-Ramos PF, Raphael C, Waldron A (2015) Civic play and civic gaps: Can life simulation games advance educational equity? J Inform Tech Polit 12:378–395. https://doi.org/10.1080/19331681.2015.1101038
67. Alves-Oliveira P, Budhiraja T, So S et al (2022) Robot-mediated interventions for youth mental health. Des Health 6:138–162. https://doi.org/10.1080/24735132.2022.2101825
68. Zhao S (2006) Humanoid social robots as a medium of communication. New Media Soc 8:401–419. https://doi.org/10.1177/1461444806061951
69. Thunberg S, Ziemke T (2020) Are people ready for social robots in public spaces? In: Companion of the 2020 ACM/IEEE international conference on human-robot interaction. Association for Computing Machinery, New York, pp 482–484
70. Šabanović S (2010) Robots in society, society in robots. Int J Soc Robot 2:439–450. https://doi.org/10.1007/s12369-010-0066-7
71. Seibt J, Flensborg Damholdt M, Vestergaard C (2018) Five principles of integrative social robotics. Envisioning robots in society—power, politics, and public space, pp 28–42. https://doi.org/10.3233/978-1-61499-931-7-28
72. Oleson K, Björling EA, Zhang L, Dwikat H (2022) Public versus private: how teens perceived teen-robot interactions in a school setting. In: 2022 17th ACM/IEEE international conference on human-robot interaction (HRI), pp 955–958
73. Navarrete CC (2013) Creative thinking in digital game design and development: a case study. Comput Educ 69:320–331. https://doi.org/10.1016/j.compedu.2013.07.025
74. Ahtinen A, Kaipainen K, Jarske S, Väänänen K (2023) Supporting remote social robot design collaboration with online canvases: lessons learned from facilitators' and participants' experiences. Int J Soc Robot. https://doi.org/10.1007/s12369-023-00966-6

Salla Jarske is a doctoral researcher in the research group of Human-Centered Technology (IHTE) at Tampere University. Her research topics concern social aspects of human-robot interaction, human-centered design of social robots, and robot literacy of older adults.

Kirsikka Kaipainen works as a project manager and a coordinator of the Digital and Sustainability Transitions in Society research platform at Tampere University. She received a PhD degree in the field of ICT for health from Tampere University of Technology in 2014. Kirsikka has studied the applicability of social robotics in the contexts of education, healthcare and young people's societal participation. More broadly, she is interested in how technologies can be used to promote sustainability, equality and wellbeing, and in the sustainability of technology itself.

Aino Ahtinen (Ph.D., M. Psych.) is a University Lecturer in Master's Degree Programme Human-Technology Interaction (HTI) in the unit of Computing Sciences, Tampere University, Finland. She teaches psychology, social robotics and cross-cultural design. Her research interests are robotassisted learning and educational robotics. She is the founder of Robostudio, a co-learning space with social robots. She has more than 20 years of experience in user experience and human-centered design in industry and academia. In 2022, she was awarded with Excellence in Teaching and Pedagogical Development Award at Tampere University.

Jari Varsaluoma is a university lecturer in the Human-Technology Interaction research group at the Unit of Computing Sciences, Tampere University, Finland. He has over 10 years of research experience in human-technology interaction projects, collaborating closely with industry in domains such as mobile learning, wearable wellness technology, and machinery automation. Jari teaches university courses on designing user interfaces, human-centered design, and service design. His recent research focuses on supporting youth's societal participation through digital means.

Kaisa Väänänen is a full professor of Human-Technology Interaction at Tampere University. Kaisa has over 25 years of experience of research in university and industry - in 1995-2004, she worked at Nokia Inc. Her research topics cover user experience with social robots, human-centered AI design, and novel technologies for citizens in urban contexts. She also has extensive teaching and supervision experience we well as leadership of study programmes on both Msc and doctoral levels. Kaisa is very active in the international research community, and frequently co-organises conferences in human-computer interaction, such as ACM CHI in 2023 and Intelligent User Interfaces in 2025.