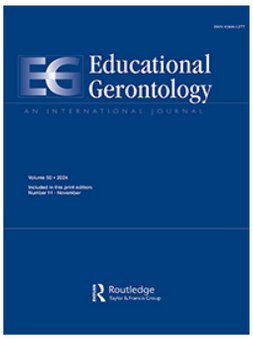

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Older adults and robot literacy

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ABSTRACT

Robots have acquired roles in the provision of information and services. Older adults may interact with robots in many settings, including their homes and public places and, for example, care settings in or outside their homes. In older adults' care, robots are used to assist their daily tasks, such as cleaning, eating, dressing, bathing, social interaction, entertainment, and medication taking. Consequently, older adults are required to have robot literacy, which has been suggested as a subset of media literacy. However, up to date, only a few researchers have defined robot literacy. In this conceptual article, we first discuss robots in the everyday lives of older adults. Second, drawing on previous studies on media literacies, digital competences, human-robot interaction and other relevant research fields, we define robot literacy as a multidimensional set of skills comprising the following seven skill dimensions: 1) awareness of robots; 2) interaction with robots; 3) understanding and evaluation of the information provided by robots; 4) understanding the data security and privacy of robots; 5) programming of robots; 6) ethical reflection; and 7) providing and receiving social support. Finally, we discuss the applicability of the concept of robot literacy and the limitations of our definition of the concept.

Introduction

Robots have acquired roles in the provision of information and services. They are becoming more popular in domestic and institutional contexts, such as in the care of older adults, where they are viewed as a possible solution for the aging population's needs for care services (Turja et al., 2020) and for the problem of social isolation (Abou Allaban et al., 2020). Consequently, older adults are required to have robot literacy, which has been suggested to be a subset of media literacy (Suto, 2013; Suto & Sakamoto, 2014; Rasi-Heikkinen, 2022; Rasi-Heikkinen & Airola, 2022).

Here, we understand robots as new media that are similar to traditional print and audiovisual media (e.g., newspapers, radio, television) and other new digital media (e.g., the internet) in that robots are channels to communicate and interact with humans (Taipale & Fortunati, 2018; Zhao, 2006). In this respect robots fall within the definition of media as 'the physical or technical means of converting a communication message into a signal capable of being transmitted along a given channel' (Watson & Hill, 2020, p. 184). Robots can communicate messages and interact with humans both verbally and non-verbally.

However, robots differ significantly from both traditional and digital media. Social robots may employ facial and bodily expressions, gaze directions and voices when interacting with humans (Zhao, 2006), and some robots are capable of moving in their environment and performing a wide range of tasks. Furthermore, humanoid social robots differ from other digital media in that 'they are not a medium through which humans interact, but rather a medium with which humans

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interact' (Zhao, 2006, pp. 402–403). For these reasons, we argue that interaction with robots requires specific skills from their users, and that the traditional definitions of media literacy do not sufficiently encompass these skills. Typically, media literacy is defined as the ability to access, analyze, evaluate, communicate, and create media messages in different contexts (Aufderheide, 1993; Hobbs, 2010; Ptaszek, 2019). We argue that the traditional definition of media literacy needs to be extended by defining robot literacy as its subset (see also Suto, 2013) in a similar way that, for example, news literacy is considered its subset. We understand media literacies as dynamic sets of competences that coexist with the changing world and accelerating development of digital technologies (Livingstone, 2004; Ptaszek, 2019). We draw on a media-dependent perspective on media literacies, according to which 'literacy, by extension, cannot be conceived solely as a feature of the user but must also be seen as medium-dependent, a co-production of the interactive engagement between technology and user' (Livingstone, 2004, p. 12).

In our definition of robot literacy, we focus on *physical robots*, that is, robots that have a physical embodiment, and that are capable of performing useful tasks for older adults in various settings of their everyday life. According to The International Organization for Standardization (ISO, 2012) standard 8373, robot is an 'actuated mechanism programmable in two or more axes with a degree of autonomy, moving within its environment, to perform intended tasks.' The physical embodiment enables the robot to conduct useful tasks in care settings, for example, feeding, washing and cleaning (Vercelli et al., 2018). These robots are called assistive or care robots. In addition, physical embodiment plays a vital role in acceptance, interaction and feasibility of the robots especially in socially interactive tasks, such as companionship and learning (Deng et al., 2019). These robots can be called social robots, socially assistive robots, or socially interactive robots.

The few existing definitions of robot literacy target children and young people. In his pioneering definition, Suto (2013, p. 139) outlined robot literacy in broad terms as 'the means of forming an appropriate relationship with intelligent robots' without describing its dimensions in more detail. In his later work, Suto together with Sakamoto (2014, p. 100), defined robot literacy as 'an ability which is required when we live with home robots.' Their 'robot literacy educational model' encompasses understanding and skills in three domains: *service* (e.g., purpose, coding, motion, design concept), *user* (e.g., culture, gender, generation, education, experience), and *production* (e.g., technology, management, distribution, regulation, law). In the context of K-12 Education, the concepts of robotics literacy or robot literacy have been used to refer to children's and young people's skills in designing, building, and programming robots (Boraita et al., 2020; Zaranis, 2021). Thus, a more nuanced definition of robot literacy inclusive of older adults is lacking from the literature, and the present study contributes to addressing this research gap.

In a similar vein, Ng et al. (2021) concluded that AI literacy has not yet been widely studied in educational sciences. Based on their review, they proposed that AI literacy includes the aspects of knowing and understanding; using; evaluating and creating; and ethical issues. Robot literacy as a separate concept from AI literacy is, however, warranted, as robots are not necessarily combined with AI, and if combined with AI, they are a unique form of *embodied* AI (Coeckelbergh, 2022).

In her preliminary conceptualization of robot literacy, Rasi-Heikkinen (2022; see also Rasi-Heikkinen & Airola, 2022) outlined that the following four competencies are needed when interacting with robots and utilizing the services and information they provide: '1) communicating with robots; 2) evaluating the information provided by the robot; 3) understanding the production process of the information and services provided by the robot; and 4) understanding the characteristics and functions of robots' (Rasi-Heikkinen, 2022, p. 53). Here, we introduce a revised version of the concept into educational gerontology and related research fields. Our definition is intended to provide a theoretical foundation for *teaching* and *evaluating* robot literacy among older adults. The aim is to support awareness-raising and educational practices in formal, informal, and nonformal settings. Thus, our research addresses the need within educational gerontology, advocated by Formosa (2021, p. 1569), to conduct 'more research on the valuing and recognition of late-life learning that takes place outside formal and nonformal contexts.'

First, to argue that older adults need robot literacy, we discuss robots in the everyday lives of older adults. Second, we introduce our definition of robot literacy through describing its seven skill dimensions, and how we developed the dimensions. Here, older adults are defined as people over 65 years of age. However, we acknowledge that people chronologically over 65 years of age are not a homogenous group but rather a diverse and socially differentiated group (e.g., Garattini & Prendergast, 2015), not least in terms of their media literacies (Rasi-Heikkinen, 2022).

Robots in older adults' everyday lives

Service robots are robots that perform useful tasks for humans or equipment, excluding industrial automation applications (ISO, 2012). Service robots may perform a single task (e.g., vacuuming, grocery delivery) or a variety of tasks such as in the case of a butler robot that delivers amenities for the quests and facilitates communication between hotel employees and quests (Clemons et al., 2022). Older adults may interact with service robots in many settings such as libraries, museums, hotels, restaurants, cafes, hospitals, nursing homes, and their private homes (Bardaro et al., 2022). Service robots may include interactions with humans, and those robots we call socially assistive robots, socially interactive robots or social robots (Deng et al., 2019; Kachouie et al., 2014; Khosla et al., 2021). Bartneck and Forlizzi (2004) define *social robots* as follows: 'A social robot is an autonomous or semi-autonomous robot that interacts and communicates with humans by following the behavioral norms expected by the people with whom the robot is intended to interact' (p. 592).

In the context of older adults' care, robots are used for numerous purposes. The use of robots in *older adults' care* can be delineated into at least five categories: 1) robots as assistants; 2) robots as providers of information and instructions; 3) robots monitoring older adults' behavior and health; 4) robots as providers of companionship; and 5) robots as providers of entertainment and opportunities for activities such as reminiscence and physical training (Vercelli et al., 2018). In older adults' care, robots are used as *assistants* to facilitate their daily tasks, such as cleaning, eating, dressing, bathing, social interaction, entertainment, and taking medication (Bardaro et al., 2022; Niemelä & Melkas, 2019; Van Aerschot & Parviainen, 2020). Even if the role of robots in older adults' care still remains rather marginal, robotics to support living at home can include, for example, monitoring and medication-dispensing robots, robot vacuums, and robot pets (Van Aerschot & Parviainen, 2020). Robots can be used as *providers of information and instructions*. Older adults may, for example, follow the instructions and schedule programmed into a medication dispensing robot at their home (Rasi-Heikkinen & Airola, 2022). Furthermore, robots may provide health-related advice and recommendations in home environments or health facilities in the foreseeable future (Giorgi et al., 2023). *Robots to monitor older adults' behavior and health* include, for example, Dori, which is a robot for assisted living that can detect and recognize movement by sensing human poses (Kim et al., 2022).

Social robots are used to provide *companionship, entertainment and engagement* for older adults in many ways: physically, cognitively, and emotionally. Social robots may also be so-called humanoids, meaning that 'the robots have some physical characteristics similar to humans, such as arms, a torso, and a head with some facial features. Although these robots are seemingly interactive, the dialogue is almost always preprogrammed' (Turja et al., 2020, p. 1). Nao and Pepper robots developed by SoftBank Robotics are typical examples of humanoid robots. They have a partly human-like appearance and human – robot interaction abilities (speech, facial, and bodily expressions and movements). The Nao robot has been tested with older adults, for example, as an assistant in a memory training program for individuals with mild cognitive impairment (Pino et al., 2020), while Pepper has been studied with older adults in a care facility when supporting physical activation, cognitive training, and social facilitation (Carros et al., 2020).

In addition to the humanoid form, a *zoomorphic* (animal-like) form seems to be a potential form for robots that interact with older adults. For example, Paro is a seal-like robot that has been developed especially as a companion robot for older adults. According to a systematic review of articles about Paro, it seems that Paro can support older adults in several ways, for example by improving quality of

life and reducing drug usage (X. Wang et al., 2022). In a study by Wu et al. (2023), Spot, a zoomorphic robot, was piloted as a walking companion. The perceptions and experiences of the older adults were positive toward the concept of walking with Spot, and they considered Spot to be an obedient and friendly companion. However, regarding the effectiveness of social robots for older adults' health and quality of life, mixed results have been reported in previous studies (Pu et al., 2019).

Introducing robot literacy

The present research is conducted as part of a larger design-based research (DBR, see Barab & Squire, 2004; Edelson, 2002), during which our preliminary concept of robot literacy (see Rasi-Heikkinen, 2022) is tested, investigated, and refined. Here, we report on the first cycle of the DBR, during which we conducted a problem analysis (Edelson, 2002) of the challenges experienced by older adults when interacting with robots, and based on that, refined our previous definition. The second DBR cycle will then include testing the concept of robot literacy among older adults through empirical studies.

Our method to develop the robot literacy framework was, first, to review and evaluate existing key frameworks of media literacy (Aufderheide, 1993; Buckingham, 2003; Hobbs, 2010; Ofcom, 2023; Sonck et al., 2011) and digital competence (Vuorikari et al., 2022) with respect to whether and how they could be applied to the skills needed from older adults when interacting with robots. In our review and evaluation of the existing frameworks, we used knowledge produced in human – robot interaction (HRI) research and other relevant research fields. This knowledge helped us gain insights into the problems and challenges experienced by older adults in their interaction with robots.

Our definition of robot literacy comprises the following seven skill dimensions: 1) awareness of robots; 2) interaction with robots; 3) understanding and evaluation of the information provided by robots; 4) understanding the data security and privacy of robots; 5) programming of robots; 6) ethical reflection; and 7) providing and receiving social support. Although the dimensions are presented here as separate entities, the dimensions are partly overlapping and interactive. Furthermore, we draw on the perspective of contextual media literacy; that is, we understand that the specific robot literacy levels that are meaningful for older adults depend on their specific country and economic context (see UNESCO, 2018). Whereas some countries, such as Japan, have been active in the development of robotics, in many countries, older adults have limited opportunities to encounter robots (Coco et al., 2018; Neven & Leeson, 2015; Vercelli et al., 2018). The Table 1 presents the seven skill dimensions of robot literacy and the existing frameworks and studies that the dimensions are based on.

The backbone of our definition of robot literacy is the traditional understanding of media literacy as, first, an individual's *access* to and *use* of media; secondly, as a critical *analysis* and *understanding* of various media contents; and thirdly, as the own *creation* of media contents (Aufderheide, 1993). In addition, the definition draws on the digital competence framework DigComp (Vuorikari et al., 2022), in which digital competence entails the following competence areas: *information and data literacy*; *communication and collaboration*; *digital content creation*; *safety*; and *problem solving*. All of the skill dimensions of our definition of robot literacy draw on these two frameworks but have been expanded with more recent media literacy and HRI research.

Awareness of robots

The first step toward robot literacy is what we call awareness of robots (cf. Kennedy et al., 2023); that is, having 'knowledge and understanding of what a robot is and what are their mechanisms, how do the robots work, how do they look like and what do they do' (Ahtinen, Beheshtian, et al., 2023, p. 331). Robot literacy also includes awareness of their possible functions and areas of use, such as education (see Ahtinen, Beheshtian, et al., 2023) and elderly care, as well as awareness of different types of robots (see, e.g., Van Aerschot & Parviainen, 2020). Echoing Kennedy et al. (2023) research on awareness of AI, we understand that citizens' awareness of robots is the first step toward a broader public discussion about the appropriate roles and boundaries for robotics.

Table 1. Dimensions of robot literacy among older adults and their connections with previous research.

Dimensions of robot literacy	Media literacy and digital competence research	Human-robot interaction research and other relevant research
1. Awareness of robots	• Awareness of media as implicitly part of access, use, understanding and creation of media contents (e.g., Aufderheide, 1993). • DigComp: e.g., awareness of the operating logics of online environments as part of Information and data literacy (Vuorikari et al., 2022).	• Characteristics, functions, limitations, areas of use, types of robots (e.g., Ahtinen, Beheshtian, et al., 2023; Van Aerschot & Parviainen, 2020).
2. Interaction with robots	• Access, use and creation of diverse and rapidly changing media messages (Aufderheide, 1993; Buckingham, 2003). • DigComp: skills to interact through a variety of digital technologies (e.g., chatbots) as part of Communication and Collaboration.	• Verbal interaction (e.g., 2020; Li et al., 2023). • Non-verbal interaction (e.g., 2020; Bonarini, 2020; Han et al., 2012; Mayr-Dorn et al., 2023; Zhang et al., 2023). • Forming a meaningful relationship with the robot (Airola, 2022; Fox & Gambino, 2021; Ihamäki & Heljakka, 2024; Rasi-Heikkinen & Airola, 2022).
3. Understanding and evaluation of the information provided by robots	• Critical understanding of the information and its' production process and contexts (Aufderheide, 1993; Buckingham, 2003; Hobbs, 2010; Ofcom, 2023). • DigComp: evaluating data, information and digital content as part of Information and data literacy	• Mechanisms of AI-driven media technologies (Jiang & Vetter, 2020; Valtonen et al., 2019). • Values behind and comprehension of robots' functions, roles, and consequences (Serholt et al., 2022). • Public imaginary of robots (Coeckelbergh, 2022).
4. Understanding the data security and privacy of robots	• Protecting ones data security and privacy (Ofcom, 2023; Sonck et al., 2011). • DigComp: protecting personal data and privacy as part of Safety (Vuorikari et al., 2022).	• Tracking, processing and storing personal data (e.g., Ahtinen, Beheshtian, et al., 2023; Gochoo et al., 2021; Pagallo, 2013; Sharkey & Sharkey, 2012).
5. Programming of robots	• Programming as a subset of media literacy (Boraita et al., 2020; Martin, 2019; Valtonen et al., 2019) • DigComp: programming as part of Digital content creation (Vuorikari et al., 2022).	• Programming language (e.g., Sayago & Bergantiños, 2021; Zhang et al., 2023). • Coding, logical and creative thinking, mathematics, problem solving (e.g., Boraita et al., 2020; Martin, 2019; Zeng et al., 2023).
6. Ethical reflection	• Ability to reflect on one's own identity and lived experience, communication behavior and conduct (Hobbs, 2010). • DigComp: e.g., readiness to contemplate ethical questions related to AI systems (Vuorikari et al., 2022)	• Ethical reflection on the design, uptake, use and consequences of robotics, e.g., on security and privacy, well-being, care, justice (Boada et al., 2021; Serholt et al., 2022), and the good life (Coeckelbergh, 2022).
7. Providing and receiving social support	• Ability to 'act,' i.e., to share knowledge and solve problems in the family and beyond (Hobbs, 2010). • DigComp: helping and guiding others in the uptake and use of digital technologies as part of Problem solving (Vuorikari et al., 2022).	• Co-learning of robotics (Ahtinen, Beheshtian, et al., 2023). • Social support in older adults' use of digital media and services (Bakardjieva, 2005; Hänninen et al., 2021; Marler & Hargittai, 2022), and robotic services (Airola, 2022; Airola & Rasi, 2020).

Interaction with robots

Although some robots, such as humanoid robots, can communicate almost like a human, robot literacy includes an understanding of robots as technical devices and that certain competencies are needed when interacting with them (Coeckelbergh, 2022). For example, in verbal interactions, users may need to time their speech more carefully, and different accents may be problematic (see, e.g., Li et al., 2023). In nonverbal interaction with a robot, its physical form, such as weight and shape (Bonarini, 2020), movements, proximity, and gestures, are meaningful (Han et al., 2012; Zhang et al., 2023), as well as the sounds and events it produces (Mayr-Dorn et al., 2023). Interestingly, previous studies have indicated that older adults may form emotional relationships

with robots (e.g., Airola, 2022; Ihamäki & Heljakka, 2024; Rasi-Heikkinen & Airola, 2022). Therefore, one could argue that forming a meaningful human-robot relationship (see Fox & Gambino, 2021) is part of robot literacy.

Understanding and evaluation of the information provided by robots

A key component of media literacy is the ability to understand and critically evaluate the information provided by media (Aufderheide, 1993; Hobbs, 2010; Ofcom, 2023) – in this case, by robots, with respect to the information's quality, truthfulness, credibility, and point of view, while also considering and understanding the potential effects of the messages (Hobbs, 2010). Questions such as the following are warranted: Who programmed the robot, why, and from what point of view? Who configured the robot? Who regulates the use of the robot (e.g., the databases and sources from which the robot fetches its information)? Regulation is particularly important when medical information is provided by a robot.

The concept of media literacy also encompasses a broader understanding of the social, economic, and historical contexts in which media content is produced, distributed, and used (Aufderheide, 1993; Buckingham, 2003). Understanding the mechanisms of algorithm-driven media technologies is essential (Jiang & Vetter, 2020; Valtonen et al., 2019), as well as a critical understanding of the values behind and comprehension of robots' functions, roles, and consequences (Serholt et al., 2022). Robot literacy also entails understanding the public imaginary of robots as the object of fear and fascination (see Coeckelbergh, 2022).

Understanding the data security and privacy of robots

In media literacy and digital competence research, protecting data security and privacy and thus safety online has been defined as a key skill (e.g., Ofcom, 2023; Sonck et al., 2011; Vuorikari et al., 2022). Social robots track, process, and store personal data (images, video, and audio) from users to enable multimodal interaction and are typically connected to an external cloud (Pagallo, 2013). Thus, there is a need to understand 'which personal data the robot is collecting, using, storing and sharing, and which parties are involved in the personal data processing' (Ahtinen, Beheshtian, et al., 2023, p. 338). Furthermore, asking questions such as the following is warranted: What kind of control do we have over the data collection? Where are the data stored? Which stakeholders can access the data? However, finding and understanding this information in the robot companies' internet resources can be challenging (Ahtinen, Chowdhury, et al., 2023).

Employing social robots in homes and in other private contexts like care homes can raise privacy concerns, as social robots are connected to sensors, cameras, range finders, and accelerometers, and thereby access people's personal and sensitive data, as well as personal spaces (see Ahtinen, Beheshtian, et al., 2023). In addition, due to the tendency to form trusted relationships with robots, older people could deliver personal data when interacting with the robot (B. Wang & Rau, 2019). Robot literacy therefore entails an understanding that it is recommended to use only robots that have been developed with privacy-sensitive approaches (Ahtinen, Chowdhury, et al., 2023; Chatzimichali et al., 2020; Gochoo et al., 2021; Sharkey & Sharkey, 2012).

Programming of robots

Programming skills have been put forward as a subset of media literacy (e.g. Valtonen et al., 2019) and digital competence (Vuorikari et al., 2022). Programming skills are internationally promoted in basic education systems (e.g., Boraita et al., 2020). Robot programming entails skills and an understanding of the programming language (Boraita et al., 2020), as well as skills such as coding, logical and creative thinking, mathematics, and problem-solving (e.g., Boraita et al., 2020; Martin, 2019; Zeng et al., 2023).

Some older adults are motivated to and capable of learning programming, and should be provided with learning opportunities (Guo, 2017; Sayago & Bergantiños, 2021).

Ethical reflection

According to Hobbs (2010), reflection within the media literacy framework means 'applying social responsibility and ethical principles to one's own identity and lived experience, communication behavior and conduct' (p. 19). In the DigComp framework, readiness to contemplate ethical questions related to, for example, AI systems has been outlined as a competence (Vuorikari et al., 2022). In terms of robots as a unique genre of media, numerous ethical questions and concerns have arisen, for example, related to potential problems arising from robot caregivers, such as increased loneliness of older adults, threats to their privacy and data protection, issues of older adults' safety, dignity, and autonomy, and threats to attentiveness, responsibility, and reciprocity in elderly care (see Abou Allaban et al., 2020; Rasi-Heikkinen, 2022). Therefore, older adults' robot literacy entails engaging in ethical reflection on the uptake, use, and consequences of robotics from the viewpoints of well-being, care, justice (Boada et al., 2021), and the good life (Coeckelbergh, 2022).

Providing and receiving social support

Finally, we include in our definition of robot literacy the ability to provide and receive social support on robotics-related questions, the latter of which also includes the ability to find help. The dimension is in line with the media literacy framework by Hobbs (2010), who defines the ability to act pro-socially as an integral dimension of media literacy. Furthermore, we follow the DigComp framework (Vuorikari et al., 2022) that identifies helping and guiding others in digital matters as a digital competence. Thus, at least at the advanced level, robot literacy may include skills in helping and guiding others in the uptake and use of robots.

Providing and receiving social support is key when older adults learn to use digital media and services (Bakardjieva, 2005; Hänninen et al., 2021; Marler & Hargittai, 2022), including robotic services (Airola, 2022; Airola & Rasi, 2020). Peer support and co-learning among older adults can benefit both the support provider and its recipient in the uptake and use of digital media (Rivinen, 2021), including robots (Ahtinen, Beheshtian, et al., 2023).

Discussion and conclusions

In this conceptual article, we introduced the concept of robot literacy for *teaching* and *evaluating* robot literacy among older adults. Our definition draws on previous empirical research on media literacy, digital competence, human – robot interaction, other relevant research fields, and the authors' previous research (Ahtinen, Beheshtian, et al., 2023; Rasi-Heikkinen, 2022; Rasi-Heikkinen & Airola, 2022). Our definition applies to awareness-raising and educational practices aimed at promoting older adults' media literacies (see e.g., Rasi-Heikkinen, 2022; Rivinen, 2021). Although robots have become more familiar in various settings, awareness of their types, functions, limitations, and ethical issues is still limited among older adults (cf. Kennedy et al., 2023).

Our rationale for developing the concept of robot literacy is, first, that media literacy is and should be seen as a dynamic set of competencies that change as technologies advance and are accessed by new groups of people (Livingstone, 2004; Potter, 2022; Ptaszek, 2019). As a medium, a robot is distinctively different from more traditional mass media, such as news, thus requiring partly different media literacies. Therefore, the concept of media literacy alone is not enough to cover the competences needed to interact with robots.

This conceptual article represents the first cycle of the authors' interdisciplinary DBR process to develop the concept. The authors represent adult education, media literacy education, and human – robot interaction. To promote older adults' agency in digitalized society, it is key to continue studying

their media literacies, robot literacy included. Robots will continue to raise ethical questions and strong reactions among older adults, professionals, and the public. Thus, ethical reflection is included as one of the dimensions of robot literacy, with the aim of contributing to ethical discussions about robotics.

Limitations

Our study can be criticized for adding yet another concept to the field of media literacy research that already includes numerous overlapping concepts with media literacy subsections (e.g., Potter, 2022; Wuyckens et al., 2021). Indeed, the necessity of the concept of robot literacy can and should be questioned. In their systematic meta-review of the concepts of media literacy, information literacy, and digital literacy, Wuyckens et al. (2021) identified conceptual inflation, a lack of shared definitions, and potentially problematic interdisciplinarity as research weaknesses. By problematic interdisciplinarity, they mean multidisciplinary studies where the disciplinary and theoretical backgrounds of studies are not explained, thus leading to 'multidisciplinarity, rather than to interdisciplinarity entailing an explicit and critical linkage of contributions based on their respective backgrounds' (Wuyckens et al., 2021 p. 10). Furthermore, they argued that most of the reviews included in their meta-review 'attest to significant difficulties in operationalizing the key literacy concepts brought to the fore by the literature' (Wuyckens et al., 2021 p. 11).

To address the critique of Wuyckens et al. (2021) concerning the potentially problematic interdisciplinarity of media literacy concepts, in this article, we explained the disciplinary background of our concept. Finally, in our ongoing DBR process, we will empirically test and refine the concept and thereby respond to Wuyckens et al.'s (2021) concerns about researchers' difficulties in operationalizing the concept of media literacy. We are presently constructing a national survey on adults' media and robot literacies. In addition, we will study real-life situations involving the use of robots in welfare services, and organize hands-on robot literacy workshops, where the use of humanoid robots will be tested with groups of older adults, namely Sámi people and care home residents (80+).

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