AGEING IN A DIGITAL SOCIETY
An occupational perspective on social participation

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An Occupational Perspective on Social Participation

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“I’ve come up with a set of rules that describe our reactions to technologies:

1. Anything that is in the world when you’re born is normal and ordinary and is just a natural part of the way the world works.

2. Anything that’s invented between when you’re fifteen and thirty-five is new and exciting and revolutionary and you can probably get a career in it.

3. Anything invented after you’re thirty-five is against the natural order of things.”

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Abstract

Background: For older adults to continue being healthy and active participants in an evolving digitalized society, there is a need to support their social participation through engagement in occupations that they need, want, or are expected to do in accordance to the roles that they assume. Occupational therapists together with other professionals face emerging challenges to promote older adults’ engagement in occupations mediated by digital technology. It is therefore relevant to acquire an understanding about how older adults continue to participate in their daily lives and engage in the occupations within their particular contexts. It is also relevant to explore ways to tailor supports for engaging in contemporary occupations and to measure the outcomes of such supports.

Aim: The overall aim of this thesis was to develop knowledge to support older adults’ social participation through engagement in occupations mediated by digital technology. Developing knowledge entailed an exploration of older adults’ engagement in occupations mediated by digital technology (Study I), their contexts surrounding social participation (Study II), and tailoring supports for engagement (Study III). Additionally, part of developing knowledge also entailed an investigation of how outcomes of tailoring – specifically ability to perform occupation mediated by digital technology and ability to manage technology – could be measured and related (Study IV).

Methods: Study participants were selected from rural and urban municipalities in Northern Sweden. In Study I, data was gathered through concurrent think aloud protocol and observations of ten older adults, aged 66-79 years, while they engaged in occupations that involved digital technology. Narrative inquiry was used to illuminate features in their occupational engagement and participation in daily life. In Study II, focus group interviews of eighteen older adults, aged 66-81 years, were conducted and analyzed using qualitative content analysis. Study III used a multiple case study methodology that included nine cases. Each case involved one adult who participated in a collaborative process to tailor supports for engagement in occupations mediated by digital technology. Data was gathered through questionnaires, observations, fieldnotes, memos for tailoring, and interviews, and then analyzed through cross-case synthesis. Nine older adults, aged 74-95 years, participated. In Study IV, twenty-five older adults, aged 71-93 years, were observed in their performances of digital technology-mediated occupations and scored on the Assessment of Computer-Related Skills and the Management of Everyday Technology Assessment. Data was analyzed using Rasch analysis and Spearman correlation test.
Results: Findings in Study I were presented as three stories reflecting facets of participation – Being alone, Belonging together, and Being alone together. The stories illuminated older adults’ participation involving digital technology as a negotiation of needs and values, refinement of identities, and experience of meaning during interactions with technological and social environments. Findings in Study II were sorted in three categories – Experiencing conditions for social participation in a state of flux, Perceiving drawbacks of urbanization on social participation, and Welcoming digital technology that facilitates daily and community living – and encapsulated in the theme The juxtaposition of narrowing offline social networks and expanding digital opportunities for social participation. The findings suggested that facilitating satisfactory use of digital technologies and co-creating usable digitalized services could support older adults’ social participation through occupations that they find relevant in their lives, and subsequently, might enable them to live longer at home. Study III resulted in a proposed scheme for tailoring to support older adults’ engagement in digital technology-mediated occupations. The scheme included various intervention strategies tailored to persons in their contexts, such as adapting visual settings on the device and forming instructional materials based on the older adults needs and preferences. Tailoring interventions require collaboration with other professionals. Results in Study IV indicated preliminary evidence of internal validity and reliability in two aforementioned instruments on a small sample of older adults. Results also showed that there is a significant and strong positive correlation between the ability to engage in digital technology-mediated occupations and the ability to manage digital technology. It implies that an older person who is more able to engage in digital technology-mediated occupations will likely have more ability to manage digital technology and vice versa. In the same manner, an older person who is less able to engage in digital technology-mediated occupations will likely have less ability to manage digital technology and vice versa.

Conclusions: In the contexts of ageing, narrowing social networks, and expanding digital possibilities, participation through satisfactory digital technology use can provide older adults opportunities to continue being active members of society. A scheme has been proposed to tailor supports for older adults’ occupational engagement, which needs further testing in various practice settings. Instruments for measuring outcomes of tailored supports have also been identified but needs further validation in studies with older people.

Keywords: computer, digital competence, digitalization, digital literacy, digital technology, information and communication technology, internet, intervention, occupation, occupational therapy, occupational therapy informatics, older adult, older people, social activities
Abstrakt

Att åldras i ett digitalt samhälle – ett aktivitetsperspektiv på social delaktighet

Bakgrund: För att äldre personer ska kunna fortsätta att vara hälsosamma och aktiva medborgare i ett digitaliserat samhälle behöver det finnas stöd för social delaktighet genom engagemang i aktiviteter som de behöver, vill eller förväntas göra i enlighet med de roller de har. Arbetsterapeuter tillsammans med andra yrkespersoner står inför nya utmaningar för att främja äldre persons engagemang i aktiviteter som utförs med hjälp av digital teknik. Det är därför relevant att få en förståelse för hur äldre personer deltar i sitt dagliga liv och engagerar sig i aktiviteter i sin kontext. Det är också relevant att utforska metoder för att skräddarsy stöd så att de ska kunna engagera sig i aktiviteter och för att mäta resultaten av dessa stöd.

Syfte: Det övergripande syftet med denna avhandling var att utveckla kunskap som kan användas för att stödja äldre persons sociala delaktighet genom engagemang i aktiviteter som utförs med hjälp av digital teknik. Detta har gjorts genom att utforska äldre persons engagemang i aktiviteter som utförs med hjälp av digital teknik (Studie I), deras kontext i samband med social delaktighet (Studie II) och skräddarsydda stöd för engagemang (Studie III). En studie syftade också till att undersöka hur förmågor kan mätas och relateras, särskilt förmågan att utföra aktiviteter med hjälp av digital teknik och förmågan att hantera teknik när skräddarsytta stöd har givits (Studie IV).


Slutsatser: I samband med krympande sociala nätverk och växande digitala möjligheter kan delaktighet genom tillfredsställande användande av digital teknik ge äldre möjligheter att fortsätta vara aktiva medlemmar i samhället. Ett strukturerat tillvägagångssätt har föreslagits i syfte att skräddarsy stöd för äldre personers aktivitetsengagemang, detta behöver ytterligare testas i fler sammanhang. Instrument för att mäta resultat av skräddarsydda stöd har också identifierats men behöver ytterligare validering i studier med äldre personer.
Original papers

This thesis is based on the following papers:


Studies I and II are published as Open Access articles. Article I is distributed under terms of the Creative Commons Attribution – Non Commercial – No Derivatives (CC BY-NC-ND) license. Article II is distributed under the terms of the Creative Commons Attribution (CC BY) license.
Preface

My father and I have a routine on Sundays. I start by using Skype to ring his landline phone. After he realizes I am on the other end of the line, my father asks “Messenger?” and I say “OK”, and we both hang up. One of us will manage to connect first, and for an hour or so, we would catch up on the week’s events. I tell him about home and health, my husband’s projects, the children’s milestones, and other interesting things happening in Sweden. He talks mostly about my late mother, my siblings, the farm, weather, and politics in the Philippines. We hardly talk about my work, with the exception of commutes and holidays. We direct our video cameras on ourselves, but I often move it around to show him the kids, the house, and the garden. The kids also talk with him, show things that they have created, and learn a few Filipino words. Our conversations end when it is time for his meal.

Much of this routine has changed over the last two decades. When my mother was still alive, she was in charge of the iPad. She would have the camera on, but most of the time, I would only see the ceiling in my parents’ bedroom, the silhouette of a finger, or foreheads. Before the tablet, they had a laptop. I would ring my nephew to turn on the laptop for them and connect to the internet. When the internet connection became erratic, which happened quite often, our conversation would be cut short. Before the laptop, I used to call them on my phone, by ringing to a service provider and then inputting a long numerical code from a scratch card and thereafter their home phone number. Our conversation ended when they reminded me how expensive the ongoing call could become. They never called me as it was so expensive then to make a phone call to Sweden. Oh, how communication technologies have developed!

I have long been interested in technology-, more specifically computer-, supported occupations. My master’s thesis in Ergonomics (2001) was about using the Hierarchical Task Analysis to break down activities involving technologies in comprehensible steps. My other master’s thesis in Occupational Therapy (2007) was about developing the Assessment of Computer-Related Skills. But my interest in the topic of my doctoral studies was kindled in those weekly calls, particularly during the earlier years, observing from afar how my parents needed help to connect to the internet, open the right app, and adjust the volume and the camera to hear us and be seen by us. My parents have been my inspiration for this work. They might not be its immediate beneficiaries, but I hope this thesis will provide other older adults an opportunity to stay in contact with their families and friends and to remain active and social for as long as they wish.
Introduction

Occupational therapists promote health by supporting people’s engagement in daily activities, also called occupations, that people need, want, or are expected to do in accordance to the roles that they assume [3, 4]. One of the dynamic and fascinating features in this profession is that occupations develop and change over time [5]. However, digital technologies have altogether transformed occupations and how people participate in life [6-8]. Opportunities to participate in many life areas including community, social, and civic life have increased because of digitalization [9-11]. At the same time, participation has become restricted for people who have no or limited access to, disinterest in, or difficulty using digital technologies [12, 13]. Older persons, for instance, can become hindered from the fully participating in life and society and from maintaining good health because of a mismatch between complex technologies and their preferences and abilities.

Consequently, occupational therapists face emerging challenges to support a diverse clientele – which includes older persons – in contemporary occupations, as well as to carry out their own work that has become more digitalized. Likewise, other professionals who work to promote older adults’ participation and health or to create inclusive digital technologies also face related challenges. This thesis therefore focuses on developing knowledge to support older adults’ social participation through engagement in occupations mediated by digital technologies.

Health is “the state of complete physical, mental and social well-being and not merely the absence of disease or infirmity” [1 p.100]. In this thesis, health also refers to “the fundamental and holistic attribute that enables people to achieve things that are important for them” [2 p.27].
Rationale

The work leading to this thesis was built on the assumptions that older persons are occupational and social beings [5, 14] and that in order to achieve good health and well-being, they must be able to identify and realize their aspirations, to satisfy their needs, and to change or cope with the environment [15]. Occupations can provide older persons opportunities to experience connectedness with others, participate in society, and attain good health and well-being. With rapid technological developments and digitalization of societies, contemporary occupations have emerged, and many traditional occupations could now be done differently with digital technologies [6, 7]. Older persons who never or infrequently use digital technologies do not have the same opportunities in society as frequent digital technology users [12, 16]. Such digital inequalities place these older persons at risk of being excluded in occupations that contribute to their connectedness with others and society and to their health and well-being [13, 17]. Therefore, their social participation through engagement in occupations should be supported, maintained, or enhanced. In such endeavors, it is important to keep in mind that social participation is embedded in current contexts that include technological developments and digitalization.

Moreover, this thesis serves as a contribution to fulfilling the commitments stated in:

1. The Political Declaration and the Madrid International Plan of Action on Ageing adopted during the Second World Assembly on Ageing [18]. The Political Declaration acknowledges that:

   - Persons, as they age, should enjoy a life of fulfilment, health, security, and active participation in the economic, cultural, and political life of their societies (Article 5);
   - The modern world has unprecedented wealth and technological capacity and has presented extraordinary opportunities: to empower men and women to reach old age in better health and with more fully realized well-being; to seek the full inclusion and participation of older persons in societies; to enable older persons to contribute more effectively to their communities and to the development of their societies; and to steadily improve care and support for older persons as they need it (Article 6); and
   - The expectations of older persons and the economic needs of society demand that older persons be able to participate in the economic, political, social, and cultural life of their societies. The empowerment of older persons and the promotion of their full participation are essential
elements for active ageing. For older persons, appropriate sustainable social support should be provided (Article 12).

2. The 2030 Agenda for Sustainable Development [19]. Supporting older adults’ social participation in a digital society are relevant to the following sustainable development goals:

- Ensure healthy lives and promote well-being for all at all ages (Goal 3). Enhancing social participation can provide opportunities for good health.
- Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all (Goal 4). Older persons need to develop knowledge and skills so that they could continue to engage in occupations that involve digital technologies and participate in society.
- Reduce inequalities within and among countries (Goal 10). Supporting older persons in occupations that require the use of digital technologies could promote their social, economic and political inclusion in digitalized societies.

3. The World Health Organization’s Global Strategy and Action Plan on Ageing and Health [20], specifically two strategic objectives:

- To develop age-friendly environments (Strategic objective 2). Enhancing older persons’ engagement in occupations mediated by digital technology could contribute towards developing an age-friendly environment.
- To improve measurement, monitoring, and research on Healthy Ageing (Strategic objective 5). Exploring older persons’ participation and contexts as well as investigating measurements on older adults’ abilities to perform digital technology-mediated occupations and manage technology could contribute to research and measurement.

4. The Swedish Action Plan for Ageing Policy (prop. 1997/98:113) [21], which declares that older people should:

- Be able to lead an active life and participate in and exert influence over society and their everyday lives;
- Be able to grow old in security and retain their independence;
- Be treated with respect; and
- Have access to good health and social care.
Background

This section starts with a description of an occupational perspective. Then, perspectives about older adults, digitalization, social participation, and confluences of these three topics will be presented. In addition, relevant concepts and works in occupational therapy will be described.

An occupational perspective

Occupation is an innate human need which can be defined as:

*groups of activities and tasks of everyday life, named, organized, and given value and meaning by individuals and a culture. Occupation is everything that people do to occupy themselves, including looking after themselves (self-care), enjoying life (leisure), and contributing to the social and economic fabric of their communities [14 p. 34]*.

As the value and meaning ascribed to occupations and the organization of occupations in daily life are distinct to each person, occupations are personal and unique [5]. Occupation provides the medium for persons to identify and realize their aspirations, to satisfy their needs, and to change or cope with the environment. Its relation to health and well-being can be further clarified by defining occupation as doing, being, belonging, and becoming [22]. *Doing* occupations can provide the means to satisfy needs and the opportunities to find meaning, choice, satisfaction, a sense of belonging, and achievement. *Being* refers to quiet contemplation, reflection, and rest in order to make sense of the doing, seek meaning and purpose, make choices, assert one’s self, and adapt to different environments. *Belonging* occurs when occupations are carried out with others in order to connect with someone, be part of something, or be attached to a place. *Becoming* relates to growth, change, and development in order to reach one’s aspirations and full potential [22].

In the Person-Environment-Occupation (PEO) Model of occupational performance [23], occupation is one of three components in transaction. Transaction between the person, environment, and occupation pertains to an interdependence between these components and leads to occupational performance. That is, persons and occupations form and are formed by their environments [5, 14]. Additionally, the person and their environments cannot exist independently of each other [23], and the interdependence between the

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*Environment* refers to physical, social, institutional, and cultural elements that are external to the person [14, 24]. It also includes the physical, social, and attitudinal factors in which people live and conduct their lives [25].
person and their environments influences the person’s performance, organization, choice, and satisfaction in occupations [14]. From a transactional viewpoint, it would be essential to study older persons and their occupations in contexts that are constantly changing (Studies I and II). In contrast, it would be unsuitable to examine the person, environments, and occupations as separate entities (Study III). It would also be important to provide supports for older adults, not directed towards a particular aspect of the person, environment, or occupation, but intentionally towards an event in which the PEO transaction manifests itself and the meaning that event holds for a person [23] (Study III). As technologies are inherent in occupations [26], it would likewise be appropriate to look into the relation between occupational performance and technology use (Study IV) to clarify the focus on occupation.

A complementary model to the PEO Model is the Canadian Model of Occupational Performance and Engagement (CMOP-E) [5]. Within the CMOP-E, the person is embedded in his or her environment, and occupation serves as a means for the person to act on the environment. In both models, occupational performance is formed by the interdependence of a person, his or her occupations, and his or her environments. However, person-environment-occupation transactions can also result in occupational engagement, according to the CMOP-E. That is, persons can engage in and take part of occupations without actually doing or performing them. The importance of occupations for a person and the satisfaction occupations brings to the person are also brought in focus in the CMOP-E. Occupational engagement is considered the broadest perspective on occupation according to the CMOP-E [5].

This thesis takes on the perspective that occupation is important for health and well-being. Additionally, performance and engagement are outcomes of transactions between the person, environment, and occupation.

**Older persons and healthy ageing**

The global population aged 60 years or more was estimated at 962 million in 2017, and this number is expected to grow [30]. Population ageing is partially due

3 Context pertains to environmental and person factors that provide the background of a person’s life and living [25].
4 Occupation and its relation to health and well-being are the core domain of occupational therapy [5, 27]. In order to clarify the profession’s occupation-centered perspective to clients and professionals in other disciplines, occupational therapists should use occupation-based and occupation-focused assessments and interventions [28].
5 The lower age limit for the older population in global and Swedish statistics differ, which is reflected in this thesis. In most developed countries, the lower age limit for older adults is 65 years, but the chronological age when a person is considered “older” is different in other parts of the world. The United Nations have adopted 60 years as a “default” lower age limit for the older population [29].
to life expectancy, which is also increasing and will continue to increase worldwide [30, 31]. Women were reported to have an average life expectancy from birth of 74.2 years and men, 69.8 years in 2016 [31]. In Sweden, the average life expectancy is 86.5 years for women and 83.9 years for men [32, 33]. The difference in average life expectancies contributes to the older population being comprised of more women than men. Women account for 54% of the global population aged 60 years or more, and 61% of the global population aged 80 years or more [30]. The predominance of women in the older population 60 years or older is also expected to persist.

Living arrangements among the older population are expectedly diverse around the world. Focusing on Northern Europe, almost one third of people aged 60 years or older live alone, while 51% live with a spouse. The percentages are reversed for people 80 years or older, such that 52% live alone and 33% live with a spouse [34]. More specific to Sweden, 39% of older adults 65 years and older live alone [33]. With regards to differences in living arrangements between men and women worldwide, older women are more likely to live alone compared to older men [30], and this likelihood increases with age [34]. In Sweden, older women tend to be more socially isolated compared to older men, and Statistics Sweden [35] surmises that the reason for this is that women often outlive their partners in old age.

Based on an examination of these demographic trends, living arrangement and differences between men and women appear to affect older persons’ opportunities for social interaction. In addition, other factors such as health decline and major life transitions due to retirement or loss of a spouse have been reported to impact on older adults’ occupations and social participation [36-38]. It then becomes relevant to explore specific contexts for opportunities and challenges relating to social participation. Insights gained from such exploration could help in understanding how to provide individualized supports to older adults as they participate in daily life and society. In addition, gender differences also reiterate the need for tailored supports, as well as person-centered occupational therapy programs in communities.

Promoting healthy and active ageing has been considered as fundamental for sustainable health and social policies in response to the growing older population [2, 39, 40]. Healthy ageing is defined as “the process of developing and maintaining the functional ability that enables well-being in older age” [2 p. 28]. Functional ability refers to both intrinsic capacities of the individual and external factors that make up the contexts around a person’s life [2]. Meanwhile, active ageing is “the process of optimizing opportunities for health, participation and security in order to enhance quality of life as people age” [41 p. 12]. Active ageing has been linked to high life satisfaction [42]. Healthy and active ageing requires
environments that support older persons’ abilities to meet basic needs, learn, make decisions, be mobile, maintain relationships, and contribute as well as ensure their protection, dignity, and care when they are no longer able to care for themselves [2, 41]. Supporting people’s functional abilities to build and maintain relationships, and to contribute to others and their communities is one of the essential strategies to achieve healthy and active ageing [2].

Older adults’ functional abilities are diverse; thus their needs are diverse. Though sensory, cognitive, and motor functions decline with increasing age, the rate of decline and how the changes are experienced by individuals vary [2, 43]. Culture plays an important role in experiences, perceptions, and expectations of ageing [44]. Furthermore, many older adults continue to make a multitude of contributions to society, while many others become frail and dependent. Individuals can successfully adapt to age-related functional changes by choosing goals and outcomes that they find most meaningful and beneficial to them [45, 46]. On the other hand, many older adults are at risk of depression, anxiety, isolation, and/or loneliness, especially when they have experienced adverse life events such as loss of a spouse or a close friend [2, 35]. Therefore, initiatives that promote active and healthy ageing should consider the diverse needs, abilities, and experiences of individuals as well as their distinct contexts [44]. From a healthy and active ageing perspective, health promotion initiatives should be tailored and targeted to enhance intrinsic person capacities and to create supportive external environmental factors.

Digitalization and digital technology

The term *digitalization* does not have a clear common definition, yet it is widely used in various settings including policy-making. In Swedish, the term *digitalisering* is used to refer to both *digitization* [49] and *digitalization* [50, 51], which may affect the understanding of its implications particularly at the grassroots level. It is not just about the “integration of digital technologies into everyday life by the digitization of everything that can be digitized” [52]. Digitalization deals with processes that restructure people’s lives around digital infrastructure and media [56]. This restructing have resulted from the convergence of elements that were then disparate [56]. That is, nowadays, the same infrastructures (e.g., telecommunication networks) and products (e.g., smart mobile phones) are used for diverse but overlapping functions and services.

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6 *Digitization* is the conversion of information, such as text, pictures, or sound, into a series of zeroes and ones so that it can be processed by a computer or other electronic equipment [47, 48].

7 *Infrastructure* refers to the basic physical and organizational structures and facilities needed for the operation of a society or enterprise [53, 54].

8 *Medium* (plural, *media*) refers to “a means by which something is communicated or expressed; and “a particular form of storage material for computer files, such as magnetic tape or discs” [55].
(e.g., communication, entertainment, information, social networking, product acquisition) by different markets (e.g., groups with varied demographics and needs). From an occupational perspective, it implies that different occupations can now be performed using similar actions on similar technological devices. It also suggests that access to diverse functions and services online have obscured concepts of time and physical space that have traditionally structured occupations, but at the same time, augmented people's opportunities and choices for occupations. However, much about digitalization's impact on occupation and social participation is not clear and hence needs to be explored. This thesis addresses this question and looks into how digital technologies have affected older persons' occupations and social participation.

Digitalization has gone beyond information and communication technology, permeating different areas of life. In this thesis, digital technology refers to digital infrastructure, tools, and media that can be used or applied in various life areas. Examples are personal computers, smartphones, and computer tablets – including applications that accompany these devices – combined with the internet and the World Wide Web [60]. Since occupations can involve a combination of infrastructure, tools, and media, this thesis adopts this broad definition of digital technology.

Digitalization has been envisioned to augment and strengthen the opportunities to work towards sustainable development [40, 50, 61] as well as to enhance possibilities to achieve good and equitable health and welfare, independence, and social participation for all [62]. It has been recognized that digitalization can support health promotion and disease prevention and improve the accessibility, quality, and affordability of health services [61]. Furthermore, the European Commission [63] in its Digital Single Market agenda aims for an inclusive digital society by improving access to services, including healthcare. Digital health, eHealth, mHealth, and telehealth are terms that have been used in literature

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9 Information technology, refers to the use of computers and the internet for management of information. Information and communications technology is a broader concept than information technology and includes telecommunications and media [57].

10 A tool has been defined as: (a) a thing used to help perform a job; and (b) software that carries out a particular function, typically creating or modifying another program [58, 59].

11 Digital health is the use of digital technologies for health. It is a broad umbrella term encompassing eHealth (which includes mHealth) as well as emerging areas such as the use of advanced computing sciences in 'big data', genomics and artificial intelligence [64 p. ix].

12 eHealth is the use of information and communication technology in support of health and health-related fields, including healthcare services, health surveillance, health literature, and health education, knowledge and research [64 p. ix; 65 p. 121].

13 mHealth, or mobile health, a subset of eHealth, is the use of mobile wireless technologies for health [64 p. ix].

14 Telehealth is the use of information and communication technologies (ICT) to deliver health-related services when the provider and client are in different physical locations [66].
and practice relating to digitalization within healthcare [61, 64-66].

To access and use digitalized services, there is a need to develop people’s digital skills and competence [61, 63, 67]. Digital competence refers to technical skills necessary to use digital tools and services as well as knowledge and skills to find, analyze, critically evaluate, and create information in various media and contexts [67]. In the European Digital Competence Framework for Citizens, five areas have been identified to make up digital competence: information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving [68, 69]. The examples provided in the framework, however, only relate to employment and learning contexts. If occupational therapists and other professionals decide to use this framework for older clients, examples relating to more appropriate contexts need to be added. On the other hand, using digitalized services would require not only knowledge and skills, but also attitudes. Digital literacy is a broader term that encompasses digital competence and includes attitudes. It is “the awareness, attitude and ability of individuals to appropriately use digital tools and facilities to identify, access, manage, integrate, evaluate, analyze and synthesize digital resources, construct new knowledge, create media expressions, and communicate with others, in the context of specific life situations, in order to enable constructive social action; and to reflect upon this process” [70 p. 155]. Digital literacy is used in this thesis for the main reasons that people’s knowledge, skills, and attitudes (not just knowledge and skills in digital competence) are situated in specific contexts and that knowledge, skills, and attitudes are equally important components that impact social participation.

**Social participation**

As older persons are occupational and social beings, being able to participate in and exert influence over society and their daily lives is important for their health and well-being. When digital technologies pervade society and the occupations of daily life, social participation becomes affected. In order to understand social participation, the terms participation and engagement need to be clarified first. Participation is involvement in life situations, according to the International Classification of Functioning, Disability, and Health (ICF) [25]. Within this definition, involvement means “taking part, being included or engaged in an area of life, being accepted, or having access to needed resources” [p. 15]. Participation together with activities, which is the “execution of a task or action by an individual” [p. 14], comprise domains of functioning [25]. There is no clear distinction between participation and activity domains within the ICF; although operational ways to make the distinction have been suggested [25]. Hammel et al. [71] argue that participation also encompasses the continuous negotiation and balancing of needs and values, along with the meaning and satisfaction resulting
from that involvement. Mallinson and Hammel [72] point out that participation results from transactions between the person, occupation, and environment. *Engagement* is distinct from participation, in such a way that engagement pertains to a commitment to do something [73]. According to a proposed framework of occupational engagement [74], individuals experience positive or negative consequences from the environment during participation. Positive consequences can be interest, engagement, or absorption; while negative consequences can be indifference, disengagement, or repulsion [74]. This connotes that *participation* is not synonymous to *engagement*. Engagement can be viewed as a positive experience that result from taking part of something.

Unlike participation, *social participation* is not defined in the ICF [25]. Nor is there a uniform definition of social participation elsewhere. Levasseur et al., through a systematic review of definitions from 43 papers on older adults, proposed to define *social participation* as “involvement in activities that provide interaction with others in society or the community” [73 p. 2144]. In a further analysis of the definitions, a taxonomy of levels of involvement in social activities with different goals was also proposed: (1) doing an activity in preparation for connecting with others; (2) being with others (alone but with other people around); (3) interacting with others (social contact) without doing a specific activity with them; (4) doing an activity with others (collaborating to reach the same goal); (5) helping others; and (6) contributing to society [73 p. 2146]. It was further distinguished that levels 1 to 6 fit in the ICF definition of participation, while levels 3 to 6 describe social participation [73]. However, this distinction can be debated, from the perspective that occupations are social practices that are formed by and are coherent with social systems in one’s particular contexts [75, 76]. That is, even occupations done in preparation for others or alone but in the presence of others are influenced by the person’s ongoing participation in his or her social systems. Thus, it appears that social participation deals with involvement in activities that provide not only interaction but also a connection with others in particular contexts.

Additionally, Aw et al. [77] described social participation as a continuum, with marginalization and exclusion at one end of the continuum, and social engagement through helping others and giving back to society at the other end. Within the continuum, older adults engage in solitary habits like watching television, seek consistency in social interactions through familiar social contacts and similar activities, and expand one’s social network to prevent loneliness and to promote active ageing [77]. If marginalization and exclusion denote minimal or a lack of interaction with others yet lie within the continuum of social participation, then social participation indeed goes beyond interaction. Accordingly, this thesis adopts a more encompassing perspective in consideration of older adults’ diverse understandings of this term and diverse digital
technology-mediated occupations done alone or in the presence of others. Social participation, as a continuum, pertains to the involvement of activities that provide a connection with others in particular contexts.

Moreover, both Levasseur et al. [73] and Aw et al. [77] considered helping others and contributing or giving back to society as social engagement. Social engagement “involves a desire for social change or to be heard to affect community choices” [73 p. 2147]. It has been described as taking part in social activities that are not mandatory [73]. It can be argued that even lower levels in the taxonomy such as doing an activity with others need not be compulsory and that engagement can be experienced even in activities are done in preparation for interaction. Though social engagement is a term often used in gerontology literature, the term engagement will be used in this thesis to refer to the positive experience resulting from participation.

**Confluences of older adults, digital technology, and social participation**

In line with a transactional perspective, older adults and ageing, digitalization and digital technology, and social participation can be better understood as they come together in various confluences. This subsection is divided into four parts: (1) ageing and technology, (2) social participation and digital technologies’ impact on health, (3) barriers to social participation and digital technology use, and (4) threats related to social participation that is dependent on digital technology.

**Gerontechnology and co-constitution of ageing and technology**

Ageing and technology are considered marginal topics within technology disciplines and gerontology, respectively [78, 79]. That is, many designers and engineers view particular aspects of ageing as design challenges when developing digital technologies, and within gerontology, technology is more often regarded as either a hinder or an intervention for functional declines among older adults [78]. Since ageing and technology (digital technology, in this thesis) occur and develop simultaneously and interactively, there is a need for a specialization that acknowledges these developments together. Gerontechnology has been conceptualized as an interdisciplinary field that focuses on technology for older adults. [79]. The three central assumptions in gerontechnology are: (1) society is driven by technological developments, and people have to keep abreast of technological developments in order to be part of society; (2) age- and gender-related differences in functioning can be bridged by improvements in the technological environments; and (3) older persons should be in control of their
technological environment [80]. Based on these assumptions, it would be appropriate to explore in particular how to adapt environments and provide opportunities for choice and control in order to promote older adults’ social participation.

Additionally, it has been argued that ageing and digital technology should be regarded as co-constituted (i.e., develop together and happen at the same time) and therefore be examined together [78]. This implies that ageing and technology should not be studied as separate entities, which fits in a transactional perspective. It also means that digital technologies have influenced older persons’ occupations and social participation. Thus, exploring older people’s engagement in occupations mediated by digital technologies that are already present in their homes can provide insight on how they negotiate their daily lives.

**Social participation and digital technology’s impact on health**

It has been acknowledged that social participation can foster healthy and active ageing [73, 81, 82]. Studies have shown that positive qualities on indices of social participation are attributable to various health benefits, such as protective effects against cognitive decline [83], depressive symptoms [84, 85], and chronic health conditions [84]. There are also differences in the indices that are linked to benefits between men and women [83–85]. For example, high social participation while concurrently performing a key role in organization (e.g., president, facilitator, treasurer) has a protective effect on men’s depressive symptoms, but not for women, especially in rural areas [85]. In addition, social activities and social support are linked to older adults’ reduced risk of mortality [86, 87]. Older adults with fewer social activities are also less likely to report positive self-perceived health and more likely to report being lonely and dissatisfied with life [88]. Loneliness, in turn, is positively related to depression and negatively associated to physical health, mental health, and quality of life [91].

Likewise, digital technologies are acknowledged to contribute to older adults’ health and well-being [61]. eHealth and mHealth in the form of computer-tailored lifestyle programs provide older individuals support and feedback to achieve healthy lifestyle goals [92]. Applications of wearable sensors and Internet of Things expand possibilities for falls prevention, monitoring, and early detection of medical conditions [93]. Furthermore, access to online information and services has been reported to help older adults feel empowered [94-96] and experience enhanced decision-making [97], self-esteem, and well-being [9].

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15 In addition to the lack of a widely-acceptable definition of social participation, the indices of social participation differ in the literature. Examples of indices include social support, social network, social activities, social relations, engagement with a friend, and formal social participation.

16 There are many definitions of loneliness [89]. In this thesis, loneliness refers to negative feelings from the absence of meaningful relationships or perceived lack of a significant other [90].
Opportunities for communication and social interaction through digital technologies have been reported to improve older adults' social skills [9], create a sense of connectedness [11, 95] or belongingness [98] as well as reduce feelings of loneliness [99, 100] and risk of social isolation [9]. Older persons who acknowledge the relevance of the digital technologies are more likely to find satisfaction in their leisure pursuits [101]. Online opportunities for leisure contribute to cognitive stimulation [9], self-worth, personal development [95], satisfaction, confidence, pride and self-respect [96]. All in all, digital technology use has provided older people more opportunities to get in contact with people with same interests, to be more connected to society, to engage in occupations, and to participate in society based on their preferences [100, 102, 103]. Considering all these benefits, there are grounds for supporting older adults' social participation through digital technologies.

**Barriers to social participation and digital technology use**

The most common barriers to social participation reported by older people are health restrictions, being too busy, and having personal or family responsibilities [88]. Older adults may fear social contact, mistrust others, or be easily overwhelmed by sensory stimuli in the presence of others [77]. In an effort to simplify their social life, some older persons prefer to go alone to activities or avoid persons they do not get along with [77, 88]. Moreover, cultural scripts can dictate social participation, such that in some cultures, making food at home and taking care of the family would take precedence over doing activities outside one's home [77]. Older adults with particular religious or ethnic backgrounds may find some social activities in their communities culturally unattractive or insensitive [77]. Other identified obstacles include transportation problems, cost and availability of social activities, and suitability in terms of time and location [88].

Similarly, health-related reasons, such as pain, cognitive decline, and other functional impairments, have been identified as barriers [11, 13, 104] to the accessibility\(^{17}\) and usability\(^{18}\) of digital technologies. In addition, time has also been perceived as a concern. Either it was lack of time, the lack of patience with how much time would be taken to use the technology, or the fear that digital technologies would be habit forming and consume time for more meaningful activities [11, 106]. However, lack of interest among older adults was identified the primary barrier for its use, as consistently seen in annual surveys by the Internet Foundation in Sweden [12, 106]. People who do not find or acknowledge

\(^{17}\) **Accessibility** refers to the “extent to which products, systems, services, environments, and facilities can be used by people from a population with the widest range of characteristics and capabilities to achieve a specified goal in a specified context of use” [105].

\(^{18}\) **Usability** is the “extent to which a system, product, or service can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use” [105].
the relevance of a digital technology are less likely to perform activities using
digital technologies and experience satisfaction from it [101, 102]. It was
reported, for example, that social media is not essential and cannot decrease
feelings of loneliness [107]. This relates to the construct, perceived usefulness,
which is the “degree to which a person believes that using a particular system
would enhance his or her performance” [108 p. 320]. Other reasons for not using
digital technologies were complicated technology, lack of access to a computer or
internet, technology being expensive and inability to use technology [12, 106].
Complex technology combined with inability to use technology influence older
adults’ perceived ease of use, which is the “extent to which a person believes that
using a particular system would be free from effort” [108 p. 320]. In technology
acceptance models [108-110], perceived usefulness and perceived ease of use are
essential attitudinal factors that determine whether person accepts and uses a
particular technology. Thus, if an older person does not perceive a specific digital
technology to be useful or easy to use, then it is less likely to be accepted and
adopted for use in daily life.

Furthermore, it has been reported that older people’s use of eHealth and mHealth
tools are impeded by: (a) personal choice, based on one’s time or priorities and
technology costs; (b) lack of adherence due to motivation and support received;
(c) unclear information about the eHealth tool; (d) barriers related to the
technology; (e) socio-demographic barriers such as age, education, skills to
manage the digital technology; and (f) institutional barriers such as lack of
resource and policy or reimbursement changes [92]. Though available, online
support groups can be experienced as unrewarding when only negative
comments are raised [92]. While digitalization enhances opportunities to access
health information and support, possibilities to access false information and
expressions of hate likewise increase [111], which can contribute to decrease in
use of digital technologies. Moreover, socio-demographic factors were also noted
by The Swedish Internet Foundation [12]. In particular, among persons older
than 65 years who do not use the internet daily, a higher percentage come from
rural areas, have primary education as highest attained level, and come from
lower income households. In addition, older individuals born outside of Sweden
tend to use the internet less [12].

Challenges in using digital technologies to support social participation have also
been identified. Older adults consider social interactions as important; therefore,
eHealth services that replace direct communication with health care personnel
are not preferred [112]. Similarly, it was expressed that contacts from social media
cannot replace contacts in real life [107]. However, lack of an offline social
network can be an obstacle to initiating social interactions online [107].
Additionally, older adults have reported being unable to install and use social
media, thus requiring assistance from others [107]. Getting oneself into online social networks or communities has been perceived as difficult [113].

**Social participation dependent on digital technology**

It has been reported that the majority of infrequent or non-users of digital technology in Sweden are older adults [12]. Although there has been an increase in older users due to previous work experience involving digital technologies [12], it is likely that older adults will disengage from digital technology use due to age-related functional declines [16]. When digitalization in fundamental sectors of society becomes prevalent and alternative channels for delivery of information, opportunities, and services become insufficient, older persons who do not have access to or use digital technology become at risk of social exclusion [16, 114]. Moreover, older people who have access to digital technology but seldom or never use them do not fully benefit from the opportunities digital technologies have to offer [16]. Since digital technologies are integrated in many life areas, older adults also become at risk of occupational deprivation, occupational marginalization, and occupational imbalance [13, 17].

**Ageing, digitalization, and occupational therapy**

**Developments in occupational therapy practice**

Since the advent of personal computers in the 1970s, only a small number of occupational therapists have highlighted opportunities related to the integration of digital technologies in occupational therapy practice. In 1975, English [119] described possible uses of computers within occupational therapy, for instance, in clients’ art and recreational activities and in data management systems. For the latter example, it was suggested that occupational therapists needed to be involved in developing such systems. More than a decade later, Spicer and McMillan [120] acknowledged computers’ potential to provide persons with impairments opportunities to experience mastery and competence, acquire skills, and gain “status in society” [p. 731]. There has been a slow advancement in occupational therapy publications on how occupational therapists used computers and other digital technologies in interventions for older adults. In

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19 **Occupational deprivation** is defined as "a state of prolonged preclusion from engagement in occupations of necessity and/or meaning due to factors which stand outside the control of the individual" [115 p.201; 116 p. 236].

20 **Occupational marginalization** is based on the argument that people need choice and control in order to participate and feel empowered, and transpires when people are excluded from occupational opportunities [117].

21 **Occupational imbalance** is based on argument that a variation of occupations would promote health and wellbeing, and occurs when some people are over-occupied while others are under-occupied or unoccupied [118].
studies published after 2000, treatment goals included improving cognition, visual and visual-motor skills, or fine coordination and dexterity [121]; improving leisure and vocational performance [121]; supporting social participation [122]; and reducing feelings of loneliness [100, 123]. Smart mobile devices were used to enhance performance in daily occupations among older persons with low vision [124]. There has also been a small number of studies in occupational therapy that focused on enhancing skills and performance in digital technology-supported occupations. Sanders et al. [125], for example, implemented a training program for older adults to improve their computer skills, while Larsson and colleagues [102, 126] implemented individualized interventions to promote digital technology-based activities among older persons. Verdonck and Maye [127] described compensatory, acquisitive, and educational strategies implemented by occupational therapists to facilitate the performances of clients with cervical spinal cord injuries in occupations using smart mobile devices. Compensatory strategies included alternative access or input devices, environmental modifications, splinting, and customization of apps. Skill acquisition strategies involved regular opportunities for practice. Education strategies consisted of information to clients and their families about using traditional assistive devices with the smart technologies and configuring their own devices.

Occupational therapists’ concerns regarding the integration of digital technologies in practice have also been discussed. In the 1975 article, occupational therapists’ acceptance of computers was posited to be a more challenging concern rather than technical problems [119]. By then, there was already an allusion to occupational therapists’ digital literacy. In 1987, factors that occupational therapists attributed to non-use of computers were lack of evidence on the effectiveness of computers in interventions, costs related to technology acquisition, lack of information to initiate use, and lack of computer literacy [120]. In 2001, Ackerman et al. [121] noted that occupational therapists do not use digital technologies in interventions for older clients because of the unavailability of technologies, lack of resources, occupational therapists’ lack of training, disinterest of older adults in technology, and non-functionality of computer goals. More current concerns raised by occupational therapists related to digital technologies consist of unfamiliarity with technologies, uncertainty on how to make adaptations, and the lack of guidelines and routines [128]. Occupational therapists’ lack of confidence in one’s digital competence was also reported [127]. In addition, Larsson-Lund and Nyman as well as Malinowsky et al. [128, 129] mentioned issues relating to professional ethics, privacy, and data security as another concern for occupational therapists.

Overall, the concerns deal with occupational therapists’ digital literacy, knowledge within occupational therapy, accessibility and resources, and clients’ goals and interests (Table 1). The first two concerns reinforce the need to enhance
occupational therapists’ digital literacy and the need to develop knowledge about assessments and interventions involving digital technologies. The third concern pertains to institutional circumstances and is expected to vary between organizations. The last concern implies a need to understand older adults’ needs, preferences, and goals that could be addressed with the help of digital technologies.

Table 1. A timeline of digital technology-related concerns raised in occupational therapy articles

<table>
<thead>
<tr>
<th>Concerns raised</th>
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<tr>
<td>Occupational therapists’ digital literacy</td>
<td>- Lack of acceptance</td>
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<td></td>
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<tr>
<td>Knowledge within occupational therapy</td>
<td>- Lack of evidence on the effectiveness of computers in interventions</td>
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<tr>
<td>Accessibility and resources</td>
<td>- Costs related to technology acquisition</td>
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<tr>
<td>Older clients’ goals and interests</td>
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Occupational therapists’ needs related to digitalization

Because technological developments will persist and occupations will evolve, occupational therapists should endeavor to enhance their digital competence [26, 127, 128]. In Sweden, digital competence is already among the competencies expected of registered occupational therapists:

Registered occupational therapists are to have competence to:

- search for information, communicate and interact digitally in relation to the profession;
- use digital systems, tools and services of relevance to the profession;
- adapt activities with respect to the transformation that digitization entails in society;
- make visible the opportunities and risks that digitalization entails for people’s activity and participation at individual, group and community levels;
- participate in the development of digital systems, tools and services of relevance to the profession [130 p. 11-12].

Examples of enhancing digital competence are exploring and familiarizing oneself with online occupations [131], observing digital technology-mediated occupations [132], and participating in competence development networks and fora [128, 131]. In addition, occupational therapists should critically review technologies that affect practice [132], and interact and collaborate with professionals from technical disciplines [26, 132].

Moreover with evolving occupations, existing occupational therapy assessment tools may become obsolete or need to be revised, and new instruments may need to be developed [133, 134]. There exist assessment instruments for occupational therapists to assess various digital technology-related constructs in people of different ages. These include the Assessment of Computer-Related Skills (ACRS) [135, 136], Assessment of Computer Task Performance [137-139], Everyday Technology Use Questionnaire (ETUQ) [140], Management of Everyday Technology Assessment (META) [141], Modified Computer Self-Efficacy Scale (mCSES) [142], and Test of Mouse Proficiency [143, 144]. Additionally, information literacy from social media is included as an item in the Inventory of Reading Occupations [145]. Among these instruments, ACRS, ETUQ, mCSES, and META have been used in studies with older adults [100, 142, 146, 147]. The ETUQ and the mCSES are instruments used in structured interviews, while the ACRS and the META are observation-based instruments. Furthermore, there is a need to understand what is actually being measured in assessment instruments and to know how constructs (that what is being measured) are related to each other. For example, ACRS is intended to measure ability to perform computer-related occupations while the META is intended to measure ability to manage
everyday technology (in this case, digital technology) [135, 141]. If technology is embedded in occupations, how would managing digital technology (e.g., managing an email app on a tablet) relate to performing occupations mediated by digital technology (e.g., writing an email on a smartphone, tablet, or a laptop computer)? This question becomes pertinent when occupational therapists need to clarify the profession’s occupation-centered perspective [28].

The need to develop knowledge about interventions has also been raised [133]. Earlier studies have pointed out the importance of finding meaning, having supportive environments for older persons [102], individualizing interventions based on the client’s interests and needs, and providing time and support for each client to set and achieve personal goals [126]. Since social and leisure activities, in which digital technologies are often used, cannot be delegated to another person or compensated without losing their benefits, interventions need to be adapted to provide individualized support [82]. From a transactional viewpoint, supporting older persons to engage or continue engaging in social and leisure occupations mediated by digital technologies would entail tailored assessment methods and intervention strategies.

To tailor means to make or adapt something for a particular person, purpose, or situation [148, 149]. Occupational therapists often modify or adapt aspects of the environment or the occupation [27] as part of a client-centered practice [5, 27]. Using a transactional approach, efforts should not be directed towards a particular aspect of the person, environment, or occupation, but rather towards a specific event in which the person, environment, and occupation transact (i.e., the person engaging in an occupation in the current context). Tailoring can be based on the person’s interests, preferences, functional abilities, and relevance [151]. As technology is an inherent part of occupation [26], its integration should be a logical procedure in tailoring, which would require occupational therapists’ digital literacy. In addition, considering the shifting context in which the person engages in an occupation would entail flexibility and creativity [150, 152]. Therefore, tailoring to support engagement in occupations involving digital technologies would require a reflection on existing models of practice [133].

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22 Being client-centered means embracing a philosophy respect for and partnership with a person receiving an occupational therapy service, and recognizing the person’s autonomy, choice, and strengths [150]. The ingress of occupational therapy work that is client-centered is the person’s understanding of his or her circumstances and needs [130].
Aim of the thesis

This thesis draws upon the idea that in order to promote healthy and active ageing in a digital society, knowledge is needed to support older adults’ social participation through digital technology-mediated occupations. The perspectives taken on to guide exploration within the studies included in this thesis are that social participation is a transaction between the older person, his or her occupations, and environment [72]. Thus, it is relevant to understand how older people engage in digital technology-mediated occupations, how such occupations are situated in their lives, and how they perceive the contexts that surround their social participation. Moreover, supporting social participation through digital technology requires new methods; therefore, part of developing knowledge is to explore how tailoring of supports focused on the older person while engaged in his or her desired occupations in context could be structured and to investigate how occupational performance and technology use could be measured and related.

The overall aim of this thesis is to develop knowledge to support older adults’ social participation through engagement in occupations mediated by digital technology. The objectives of the studies included in this thesis are:

I: To explore how older adults engage in and situate digital technology-mediated occupations in daily life;

II: To explore older adults’ perceptions about contexts surrounding their social participation in a digital society;

III: To explore how tailoring to support of older adults’ engagement in digital technology-mediated occupations could be schematized;

IV: To investigate how older adults’ ability to perform digital technology-mediated occupations and ability to manage digital technology could be measured, and to examine the association between these two abilities.
Methods

In the development of knowledge about supporting social participation through digital technology-mediated occupations, it is relevant to first gain insight about how older adults perceive and experience their social participation and engagement in digital technology-mediated occupations as well as the contexts around them. Studies I and II focused on these areas. Both studies used qualitative research designs in order to delve into the complexity of participation and occupational engagement in diverse contexts [153]. Study I used a narrative inquiry [154, 155] combined with observations of how older adults engaged in occupations involving digital technologies and concurrent think aloud protocol [156, 157] in data gathering. A narrative inquiry was chosen as it could be used to give light to distinct features of a person’s engagement in occupations. The methods in Study I allowed engagement in digital technology-mediated occupations as unfolding stories to be framed and situated the context of daily life. On the other hand, Study II used focus group methodology [158, 159] to stimulate recognition of and discussion on participant’s perceptions of their contexts surrounding social participation in a digitalized society.

The insights gained from Studies I and II then provided the foundation for understanding engagement in digital technology-mediated occupations. Study III focused on managing occupational challenges identified by older persons by tailoring supports to facilitate engagement. A multiple case study methodology [160] was chosen as it allowed for the exploration of each tailored intervention process as a case and the distinct context surrounding it. Having multiple cases provided an opportunity to examine the replicability or uniqueness of every case as well as to explore various ways of providing individualized support in context and how the process could be structured [160]. As tailoring supports implied a resolution or non-resolution of occupational issues, there was a need to investigate how outcomes or the impact of tailoring could be measured. Thus, Study IV focused on investigating how a person’s ability to perform digital technology-mediated occupations and ability to manage digital technology could be measured. Two observation-based instruments – the ACRS and the META – were used for this purpose. Cross-sectional data on older adults was used for this investigation and for further examination on whether there is correlation between the abilities measured in the ACRS and META. An overview of study designs and methods can also be seen in Table 2.
Table 2. Overview of the focus, design, and methods used in the studies

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<tr>
<td>Focus</td>
<td>Engagement in digital technology-mediated occupations</td>
<td>Contexts surrounding social participation in a digitalized society</td>
<td>Tailored intervention process to support engagement in digital technology-mediated occupations</td>
<td>Measuring abilities to perform digital technology-mediated occupations and manage technology</td>
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<tr>
<td>Design</td>
<td>Qualitative, narrative methodology</td>
<td>Qualitative, focus group methodology</td>
<td>Qualitative, multiple case study</td>
<td>Quantitative, cross-sectional, instrument comparison</td>
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<tr>
<td>Data gathering</td>
<td>Observations of occupational engagement, concurrent think aloud protocol</td>
<td>Focus group interviews</td>
<td>Structured initial interview using a battery of instruments, observations, fieldnotes, memos on tailoring, semi-structured final interview</td>
<td>Observation of occupational performance, scoring of observations using two instruments</td>
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<td>methods</td>
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<tr>
<td>Data analysis</td>
<td>Narrative analysis</td>
<td>Qualitative content analysis</td>
<td>Cross case synthesis</td>
<td>Multifaceted Rasch analyses, Spearman correlation</td>
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<td>methods</td>
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In the following subsections, methods for participant recruitment and selection as well as data collection and analysis used in Studies I-IV will be presented. In some subsections, common tools and procedures (i.e., used in more than one study) will be described first, followed by study-specific methods under respective sub-subheadings. Ethical considerations will also be explained.

**Participants**

*Recruitment and inclusion criteria*

Occupational therapy community practice can support older adults’ health and ageing in place [161]. This is the reason for choosing community-dwelling older adults as study participants. The localities that were chosen for the studies provided a breadth in community types that included rural and urban communities.
The first half of the thesis was a part of a research project to develop digitalized community services for older persons in rural communities in Northern Sweden. Hence, Studies I and II sought persons 65 years or older, who were curious what digital technologies could offer and interested to develop digitalized services for older persons. Because of the chosen data gathering methods in both studies, an inclusion criterion was the absence of any severe language impairment that could hinder communication. An additional inclusion criterion in Study I was that persons should have access to digital technology at home. Frequency of technology use was not defined as a criterion. Two rural municipalities were chosen for the studies for their existing broadband infrastructure. Local community and hobby organizations whose memberships comprise mainly older adults in those municipalities were contacted, through which the invitations to participate in Studies I and II were extended. The invitation was also sent out as a paid advertisement in a local bulletin with a free weekly distribution to all residents in one municipality. In the other municipality, the invitation was in form of a notice posted in bulletin boards in community gathering spaces. Participants for Studies I and II were selected through purposive sampling. Study II also selected participants through snowball sampling.

The second half of the thesis was a part of interregional project to promote engagement in social activities among community-dwelling older adults. Therefore, the intended participants for Studies III and IV were individuals who were 70 years or older, living in the community, with an interest in developing social activities supported by digital technologies. In order to enhance engagement in social activities together with the researchers, persons should not have any severe language impairment that could hinder communication. Neither knowledge of digital technologies nor existing access to any digital technology in one’s home was a requirement to be part of Study III. In contrast, knowledge and use of digital technologies was not required, but existing access to any digital technology in one’s home was a requirement for Study IV. Additionally for Study III, participants should be willing to be in periodic contact with researcher over a period three to six months.

Recruitment for Studies III and IV was initiated in cooperation with municipal home care service providers in a municipality in Northern Sweden. The municipal home care service provider was chosen because of their publicly-expressed need for support to improve their services. Researchers in the interregional project initiated contact and held meetings with home care staff to inform about the project, planned studies, and participant selection. In the meetings, the researchers encouraged the home care staff to consider which among their clients could be invited to participate in the studies. Home care staff secured their clients’ expressions of interest and consent to release contact information to the researchers. Those clients who expressed interest were then
contacted by the researchers and informed individually about the collaboration and the studies. The researchers and the home care clients agreed on the time the latter needed to consider participation in the studies and discuss with significant others. After the agreed time period, the researchers contacted the home care clients for their response. The recruitment process resulted in two participants for Study III. Two additional recruitment cycles were held, beginning again with meetings with home care staff, but the procedure did not result in additional participants.

The strategy for recruitment was then changed to direct invitations to community-dwelling older adults in another municipality in Northern Sweden. The second municipality was chosen because of its well-developed municipal broadband infrastructure. An information meeting was announced on a local bulletin board in a privately-owned retirement community. During the meeting, the researcher presented information about the project and the studies, and invited residents in the retirement community to participate in the studies. Interested persons who filled in a Request More Information form, were then contacted, informed individually about the studies, and contacted again after a period of time which they found reasonable to consider participation. This recruitment cycle resulted in seven additional participants for Study III. For Study IV, information meetings were held in the same retirement community at a later time, two other privately-owned retirement communities, and a municipality-arranged activity center. Participants for Study IV were selected through purposive sampling and snowball sampling. The results of the recruitment procedures can be seen in Table 3.

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<td>10</td>
<td>18</td>
<td>9</td>
<td>25</td>
</tr>
<tr>
<td>Locality 1 – rural (2013-2014)</td>
<td>6b</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Locality 2 – rural (2014)</td>
<td>4c</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Locality 3 – rural (2016)</td>
<td></td>
<td></td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Locality 4 – urban (2018)</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Locality 5 – urban (2018-2019)</td>
<td></td>
<td></td>
<td>7b</td>
<td>25</td>
</tr>
</tbody>
</table>

*a Locality refers to a town or city within a municipality.

*b All participants also participated in the succeeding study.

*c Three of four participants also participated in the succeeding study.

### Participant composition

Table 4 presents a demographic description of study participants. Table 5 presents a summary of their reported access to and use of digital technologies.
Table 4. Demographic information of participants

<table>
<thead>
<tr>
<th>Demographic information</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>10</td>
<td>18</td>
<td>9</td>
<td>25</td>
</tr>
<tr>
<td>Men</td>
<td>4</td>
<td>7</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Women</td>
<td>6</td>
<td>11</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>Age range in years</td>
<td>66-79</td>
<td>66-81</td>
<td>74-95</td>
<td>71-93</td>
</tr>
<tr>
<td>Mean age in years</td>
<td>69.7</td>
<td>72.8</td>
<td>82.7</td>
<td>82.4</td>
</tr>
<tr>
<td>Civil status</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Married</td>
<td>6</td>
<td>8</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Co-habiting</td>
<td>2</td>
<td>4</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Widowed/widower</td>
<td>0</td>
<td>3</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>Divorced</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Children</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Yes</td>
<td>10</td>
<td>18</td>
<td>9</td>
<td>23</td>
</tr>
<tr>
<td>Type of residence</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Detached single unit housing (owned)</td>
<td>9</td>
<td>13</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Attached multiple unit housing (owned)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Detached single unit housing (rented)</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Attached multiple unit housing (rented)</td>
<td>0</td>
<td>3</td>
<td>9 (7)a</td>
<td>25 (22)a</td>
</tr>
<tr>
<td>No response</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Highest educational attainment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary education</td>
<td>4</td>
<td>10</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Secondary education</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Higher education</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>13</td>
</tr>
<tr>
<td>No response</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Occupational fields</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Managers</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Occupations requiring advanced level of higher education</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>Occupations requiring higher education qualifications or equivalent</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Administration and customer service clerks</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Service, care and shop sales workers</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Agricultural, horticultural, forestry and fishery workers</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Building and manufacturing workers</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Mechanical manufacturing and transport workers, etc.</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Elementary occupations</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

a Number in parenthesis = participants living in rented units in retirement communities
b Occupational fields based on the Swedish Standard Classification of Occupations 2012 [162]
Study I
Four men and six women, aged 66-79 (mean=69.7 years) participated in Study I. To ensure reliability in using the think aloud protocol [157], the minimum number of participants should be eight persons. All but one had access to a stationary or laptop computer. Only six participants reported having access to internet from home.

Study II
Seven men and eleven women, aged 66-81 years (mean = 72.8 years), participated in the study. According to Dahlin-Ivanoff and Hultberg [158], a maximum of six persons in each group could provide everyone an opportunity to participate and make the discussion dynamic. The number of groups depended on the data saturation from the information that emerged. Four focus groups were therefore formed; each group consisted of four to six participants. The focus groups were formed based on the communities where the participants lived and their availability for the interviews. All participants had access to at least one of the following devices at home: stationary computer, laptop computer, or tablet/handheld computer.

Study III
Three men and six women, aged 74-95 years (mean=82.7 years) participated in the study for a period of 20-26 weeks. Eight persons were able to participate for the entire study period. One person was unable to participate in the final interview. All participants lived in rented flats in multiple unit dwellings in urban communities. Seven persons lived alone and were either widowed, widowered or divorced. Two persons lived as a married couple. Six persons reported having access to internet from home, but only three used it daily.

Study IV
Ten men and 15 women, aged 71-93 years (mean=82.4 years) participated in the study. Twenty-four persons reported having access to internet at home, of which 18 persons reported using daily. The participant who reported not having internet at home was observed using a smart television connected to a digital box.
Table 5. Access to technologies at home and frequency of technology use

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>10</td>
<td>18</td>
<td>9</td>
<td>25</td>
</tr>
</tbody>
</table>

**Access at home**

<table>
<thead>
<tr>
<th>Technology</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stationary computer</td>
<td>6</td>
<td>10</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Laptop computer</td>
<td>2</td>
<td>7</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>Tablet</td>
<td>1</td>
<td>5</td>
<td>5</td>
<td>18</td>
</tr>
<tr>
<td>Mobile phone</td>
<td>6</td>
<td>12</td>
<td>5</td>
<td>18</td>
</tr>
<tr>
<td>Smartphone</td>
<td>1</td>
<td>5</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>Printer</td>
<td>2</td>
<td>5</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>Internet</td>
<td>6</td>
<td>11</td>
<td>6</td>
<td>24</td>
</tr>
</tbody>
</table>

**Frequency of use**

<table>
<thead>
<tr>
<th>Technology</th>
<th>Daily</th>
<th>Sometimes</th>
<th>Rarely</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stationary computer</td>
<td>4</td>
<td>5</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>5</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Laptop computer</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Tablet</td>
<td>1</td>
<td>2</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Mobile phone</td>
<td>3</td>
<td>9</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Smartphone</td>
<td>1</td>
<td>5</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Printer</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>6</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Internet</td>
<td>4</td>
<td>8</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>3</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

*Note that some numbers do not correspond to access at home because access to technology outside of one’s home was not asked. There were also non-responses on frequency of use.*
Data collection

**Materials and tools**

A paper-based questionnaire on demographic information and participants’ access to and use of digital technologies was developed and utilized in data collection in all four studies (hereon referred to as the “shared questionnaire”). Demographic information included date of birth, sex, civil status, highest educational attainment, and living arrangements (Table 4). The shared questionnaire also included an item about access to common digital technologies and an item about frequency of use for each technology to which they had identified having access (Table 5). In Studies I and II, the participants filled in the shared questionnaire themselves. Two questions were added to the shared questionnaire in Studies III and IV, namely: *Which digital technologies do you consider important?* and *Which digital technologies you like to try or be better at using?* These questions were used to assist in identifying goals for intervention (Study III) and in identifying occupations that could be observed (Study IV). The shared questionnaire was administered as an interview guide in the latter studies.

Digital voice recorders were used to record participants’ verbalizations in the think aloud protocol (Study I) and focus group interviews (Study II). Digital video cameras were used to record participants’ occupational performances in Study I and IV.

**Study I**

Filmed observations of participants’ performances in digital technology-mediated occupations and concurrent think aloud protocol were used to gather data. Observation of occupational performance was chosen as it could provide an understanding on how the participant engaged in the occupation while impacting on and negotiating within his or her context, and simultaneously being impacted on by his or her context. During the observations, two mounted video cameras were used. One camera was pointed towards the digital screen, while the other camera was pointed towards the participants’ hands and input devices.

In the concurrent think aloud protocol, the participant was instructed to verbalize what he or she is currently doing, feeling, or thinking [157, 163] while performing the occupation. The concurrent think aloud protocol is a method used to provide insight into a person’s thought processes [156]. The method was selected because it had the potential to provide an insight into what details in the digital technology the participant is focused on, events that are perceived as challenging or problematic, strategies to manage challenges or problems, and other mental processes that occur during occupational performance. After deciding on which occupations would be performed/observed, each participant was instructed, You
have chosen to do activity X and Y. While you perform these activities, talk out loud and tell me what you are doing, feeling, or thinking. If you become quiet during the observation, then I will ask you what you are doing, feeling, or thinking, or what is happening. Would you like to practice talking out loud in a shorter activity first?

Study II

An interview guide was used and included open-ended questions about daily occupations, social networks and activities, participation in society, digital technology, and existing and desired services in the community were included. During the interview, a digital voice recorder was placed at the center of the table around which participants and moderators sat.

Study III

The initial data gathering involved a battery of instruments that included the shared questionnaire, the MNPS Interest Checklist [164-166], the Social Network Online and Offline Questionnaire [122], and the UCLA Loneliness Scale [167, 168] (Table 6). The last two questions in the shared questionnaire and MNPS Interest Checklist was used in dialog to aid participants to choose occupations that they would like to engage in during the course of the study. The latter two instruments were used in dialog to assist in identification of goals. All instruments were in Swedish and paper-based.

Additionally, a fieldnotes form was developed and used to document meetings with participants. Information gathered included date, time, physical setting, interaction between people present, purpose of the meeting, what the researcher did (including implementation of tailored intervention strategies), what therapeutic modes [169] were used, observations, responses from the participant, and reflections. Another form, memos on tailoring, was also developed and used to document preparation of tailored intervention strategies. Both forms were made on Forms in the Microsoft Office 365 services at Umeå University and could be accessed through a web browser on various digital devices. The purpose of online forms was to facilitate documentation even right after a meeting with a participant. All data entries were anonymized. Data entries were saved on the university server and could only be accessed through the researcher’s university account which was password-protected.

An interview guide was used to examine a participant’s experiences during the tailored intervention process. The interview included open-ended questions about the participant’s perceptions and experiences related to identification and own goals and planning activities, strategies and suggestions to improve
engagement, achievement of goals, using digital technologies, encounters with researcher, dialogs and communication, and being part of the study.

Table 6. Description of instruments used in Study III

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Description and what it measures</th>
<th>Pros and cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>MNPS Interest Checklist [164-166]</td>
<td>A checklist on which activities an informant is interested in, the extent to which he/she is interested in each activity, whether he/she performs or wants to perform each activity, whether he/she considers each activity important for one's wellbeing.</td>
<td>The instrument is used in occupational therapy and can identify informants’ interests. The checklist is available in Swedish. It has been validated in studies on older persons [170, 171]. It does not include interests specific to digital technologies.</td>
</tr>
<tr>
<td>Social Network Online and Offline Questionnaire [122]</td>
<td>A questionnaire for collecting information about the informant’s existing and desired social networks online and offline.</td>
<td>The instrument has been used in studies on older adults using digital technologies. It is available in Swedish. It has only been used on a small number of older adults [100, 122].</td>
</tr>
<tr>
<td>UCLA Loneliness Scale [167, 168]</td>
<td>A self-rating 5-point scale with twenty statements relating to the constructs loneliness and social isolation.</td>
<td>Validation studies are available. The instrument is available in Swedish. The statements, which are related to the experience of loneliness and social isolation, can invoke negative feelings in the respondent.</td>
</tr>
</tbody>
</table>

Study IV

In Study IV, two instruments were used to score observations during participants’ performances of digital technology-based occupations – the ACRS and the META. Participants’ performances of digital technology-mediated occupations were recorded using two video cameras. One camera was pointed towards the digital screen, while the other camera was pointed towards the participants’ hands and input devices. In instances where the digital screen and input interface could fit in the same field, only one camera was used. The purpose of the video recordings was to provide the opportunity to view the performances repeatedly for separate scorings on the ACRS and META.

Assessment of Computer-Related Skills

The ACRS is intended to assess the ability of a person to perform computer-related occupations. The 37 skills in the ACRS comprise 26 motor and process skills based on the Assessment of Motor and Process Skills (AMPS) [174] and School AMPS [175], and 11 computer-related skill items (Table 7). The person...
together with the rater chooses two to three occupations for the person to perform and the rater to observe. The criterion for the choice of occupations is that an occupation should be valuable or relevant but challenging, or novel. After each performance, the rater scores every skill item on a 4-point scale, with 4 as Competent, 3 as Questionable, 2 as Inefficient and 1 as Deficient. Items that are not observed are left blank. The ACRS has been validated on small samples of “healthy” workers and adults with rheumatoid arthritis [135, 136] and has been used in a study with older adults [100]. Training is required to use the instrument.

Table 7. Items in the Assessment of Computer-Related Skills

<table>
<thead>
<tr>
<th>Area</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interaction with the physical environment</td>
<td>PE-1 Positions self</td>
</tr>
<tr>
<td></td>
<td>PE-2 Regulates posture</td>
</tr>
<tr>
<td></td>
<td>PE-3 Moves self</td>
</tr>
<tr>
<td></td>
<td>PE-4 Locates tools and materials</td>
</tr>
<tr>
<td></td>
<td>PE-5 Selects appropriate tools and materials</td>
</tr>
<tr>
<td></td>
<td>PE-6 Uses tools and materials</td>
</tr>
<tr>
<td></td>
<td>PE-7 Handles tools and materials</td>
</tr>
<tr>
<td></td>
<td>PE-8 Manipulates tools and materials</td>
</tr>
<tr>
<td></td>
<td>PE-9 Moves tools and materials</td>
</tr>
<tr>
<td></td>
<td>PE-10 Executes coordinated movements</td>
</tr>
<tr>
<td></td>
<td>PE-11 Organizes physical environment</td>
</tr>
<tr>
<td></td>
<td>PE-12 Restores physical environment</td>
</tr>
<tr>
<td>Interaction with the virtual environment</td>
<td>VE-1 Directs pointer</td>
</tr>
<tr>
<td></td>
<td>VE-2 Locates virtual object</td>
</tr>
<tr>
<td></td>
<td>VE-3 Selects virtual object</td>
</tr>
<tr>
<td></td>
<td>VE-4 Uses virtual object</td>
</tr>
<tr>
<td></td>
<td>VE-5 Activates virtual object</td>
</tr>
<tr>
<td></td>
<td>VE-6 Inserts object</td>
</tr>
<tr>
<td></td>
<td>VE-7 Provides information</td>
</tr>
<tr>
<td></td>
<td>VE-8 Seeks information</td>
</tr>
<tr>
<td></td>
<td>VE-9 Handles virtual object</td>
</tr>
<tr>
<td></td>
<td>VE-10 Manipulates virtual object properties</td>
</tr>
<tr>
<td></td>
<td>VE-11 Moves virtual object</td>
</tr>
<tr>
<td></td>
<td>VE-12 Organizes virtual environment</td>
</tr>
<tr>
<td></td>
<td>VE-13 Restores virtual environment</td>
</tr>
<tr>
<td>Adaptation</td>
<td>AD-1 Responds to cues</td>
</tr>
<tr>
<td></td>
<td>AD-2 Modifies behavior</td>
</tr>
<tr>
<td></td>
<td>AD-3 Modifies environment</td>
</tr>
<tr>
<td></td>
<td>AD-4 Adapts performance</td>
</tr>
<tr>
<td>Temporal organization</td>
<td>TO-1 Initiates actions</td>
</tr>
<tr>
<td></td>
<td>TO-2 Continues actions</td>
</tr>
<tr>
<td></td>
<td>TO-3 Sequences actions</td>
</tr>
<tr>
<td></td>
<td>TO-4 Terminates actions</td>
</tr>
<tr>
<td></td>
<td>TO-5 Paces actions</td>
</tr>
<tr>
<td>Task completion</td>
<td>TC-1 Follows through</td>
</tr>
<tr>
<td></td>
<td>TC-2 Maintains focus</td>
</tr>
<tr>
<td></td>
<td>TC-3 Sustains effort</td>
</tr>
</tbody>
</table>
Management of Everyday Technology Assessment

The META [141] is used to assess a person’s ability to manage everyday technology. Everyday technology (ET) consists of “technological, electrical, and mechanical artifacts and services used in everyday life”, including “newly-developed technology, e.g., telephone services and Internet based services” [146] p. 99]. The META is initiated through an interview about what the person usually does and which ETs are relevant to the person or are described as troublesome. Two to four ETs are chosen for observation based on their relevance and the challenge they present for the person. The rater then observes the use of each ET and scores each observation on items related to performance skills, intrapersonal capacities, environmental characteristics, and safety and importance (Table 8). The scoring uses a 4-point scale, with 4 as Competent handling/management, 3 as Deficits in this skill occasionally or slightly disturb the person’s use of the technology, 2 as Deficits in this skill obviously disturb the person’s use of the technology, and 1 as Deficits in this skill hinder the person’s use of the technology and/or the person is in need of assistance to perform the skill completely. Scores on eleven items in Part A: Performance skills was used in Study IV. The META has been tested for validity and reliability in samples with varying age groups, diagnosis, and cognitive functions [141, 146, 172, 173]. Participation in a course and practice scoring are required to use the instrument.

Table 8. Items in the Management of Everyday Technology Assessment

<table>
<thead>
<tr>
<th>Part</th>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance skills</td>
<td>A1</td>
<td>Identify and select/separate technologies</td>
</tr>
<tr>
<td></td>
<td>A2</td>
<td>Identify and select services and functions within a technology</td>
</tr>
<tr>
<td></td>
<td>A3</td>
<td>Perform steps and actions in logical sequence</td>
</tr>
<tr>
<td></td>
<td>A4</td>
<td>Manage series of numbers/letters</td>
</tr>
<tr>
<td></td>
<td>A5</td>
<td>Choose correct button or command</td>
</tr>
<tr>
<td></td>
<td>A6</td>
<td>Turn a button or knob in correct direction and position</td>
</tr>
<tr>
<td></td>
<td>A7</td>
<td>Use appropriate force, tempo, and precision</td>
</tr>
<tr>
<td></td>
<td>A8</td>
<td>Coordinate different parts of the technology</td>
</tr>
<tr>
<td></td>
<td>A9</td>
<td>Coordinate the technology with another technology without physical contact</td>
</tr>
<tr>
<td></td>
<td>A10</td>
<td>Notice information and respond adequately</td>
</tr>
<tr>
<td></td>
<td>A11</td>
<td>Follow verbal instructions given by automatic telephone services</td>
</tr>
<tr>
<td>Environmental characteristics</td>
<td>B1</td>
<td>Contextual influence</td>
</tr>
<tr>
<td></td>
<td>B2</td>
<td>Impact of the design</td>
</tr>
<tr>
<td>Intrapersonal capacities</td>
<td>C1</td>
<td>Capacity to recall necessary information</td>
</tr>
<tr>
<td></td>
<td>C2</td>
<td>Capacity to pay attention and focus</td>
</tr>
<tr>
<td></td>
<td>C3</td>
<td>Ability to manage stress</td>
</tr>
<tr>
<td>Safety and importance</td>
<td>D1</td>
<td>Safety</td>
</tr>
<tr>
<td></td>
<td>D2</td>
<td>Client’s evaluation of technology’s importance</td>
</tr>
</tbody>
</table>
Table 9 provides additional descriptions of instruments used in Study IV.

Table 9. Description of instruments used in Study IV

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Description and what it measures</th>
<th>Pros and cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessment of Computer Related Skills (ACRS) [135]</td>
<td>An observation-based instrument intended to measure motor and process skills in performing computer-related occupations.</td>
<td>The instrument has been tested in studies done on a small number of younger adults and older adults [100, 135, 136]. Instructions and scoring sheet are in English, but participants are not required to read the material. Training is required to use the ACRS.</td>
</tr>
<tr>
<td>Management of Everyday Technology Assessment (META) [141]</td>
<td>An interview and observation-based instrument used to measure ability to manage technology in everyday life.</td>
<td>The instrument demonstrates acceptable person response validity and technology goodness-of-fit [141, 146, 172, 173]. Instrument is available in both English and Swedish, but participants are not required to read the material. Participation in a course is required to use the META.</td>
</tr>
</tbody>
</table>

Procedures

At the beginning of data collection, the shared questionnaire was presented. Participants in Studies I and II filled in the questionnaire, while in Studies III and IV, the shared questionnaire was used as a guide in a structured interview.

Study I

The data gathering procedure started with a telephone call to make an appointment for the observation and to discuss possible occupations that could be observed. Digital technology-mediated occupations that were agreed upon for observation were occupations that the participant performed regularly, was obliged to do, or identified as challenging or novel. During the actual meeting, the chosen occupations which the participant would perform were confirmed or revised. The think aloud protocol was introduced by giving the instruction to the participant to talk out loud about what he or she is doing, feeling, or thinking while performing each chosen occupation. The participant was also given the opportunity to practice doing so in a short task, which all participants declined to do. With occupations and instructions clarified, the participant performed the chosen digital technology-mediated occupations while being observed and filmed. The observations were done in the participants’ homes using their own
digital technologies. One participant who did not have access to a digital technology from home used the partner’s laptop computer. The occupations were performed by the participant in the presence of one researcher, and when both spouses or partners participated in the study, his or her spouse or partner.

**Study II**

Focus group methodology [158, 159] was chosen as it allows for an interaction between participants which could stimulate discussion, elaboration of ideas, and possible changes in views. Four focus groups were formed, and with each focus group, two semi-structured interviews were conducted. The earlier interviews dealt with how a typical day would be like, social networks and activities, and opportunities for participating in society. Succeeding interviews covered existing services, including how digital technologies are integrated in those services, and desired services in their communities. A moderator facilitated the discussion in the interviews. An assistant moderator summarized the interview and provided participants an opportunity to reflect on the discussion or comment further on the ideas discussed [176]. Each interview lasted one and a half to two hours, which included a coffee break.

**Study III**

Data collection, which spanned 20-26 weeks, began with the battery of instruments, responses from which led to dialogs on goal identification and the initiation of the tailored intervention process. The tailored intervention process comprised of goal identification, planning, intervention, and follow-up. During the goal identification and planning phases, occupations that the participant would like to engage in were chosen and prioritized. During intervention and follow-up phases, participants were provided individualized supports to facilitate engagement in digital technology-mediated occupations. Supports were contextualized and tailored based on the participant’s interests, preferences [151], needs, and goals in occupations that he or she found relevant in the context of his or her daily life. The participant’s progress on achieving his or her goal was followed-up, and the intervention strategies were continued or modified accordingly. During the tailored intervention process, information was collected in fieldnotes and memos on strategies.

A post-intervention semi-structured interview was initiated with a summary of what occurred during the participant’s tailored intervention process, which provided him or her an opportunity to reflect on the process. The interview was then conducted following an interview guide. The interviews were not recorded as participants declined being audio-recorded; note-taking was done instead.
**Study IV**

A dialog was initiated through the latter questions in the shared questionnaire to help identify digital technologies or digital technology-mediated occupations that could be used for observations. To be chosen for observations, technologies should be relevant yet challenging to do while occupations should be activities that the participant performed regularly, was obliged to do, or identified as challenging or novel. When the technologies and occupations were chosen, the participants were requested to use the technologies or perform the occupations one by one. They were observed and filmed during occupational performances and demonstrations of technology use. After the demonstrations of technology use, questions from the META on participants’ abilities to recall information, to concentrate, and to manage stress; perceptions regarding the impact of environment and the technology design; and thoughts about safety and importance of the chosen technologies were asked. Responses were marked on separate META scoring forms for each of the technologies chosen.

The video recordings were then viewed repeatedly so that scoring of each occupational performance and demonstration of technology use on the ACRS and META, respectively, could be done. Each video recording was viewed with attention to the performance of the occupation and scored on the ACRS. Then, it was viewed again with attention on the use of technology and scored on the META. Scoring was done for every occupational performance on the ACRS and every demonstration of technology use on the META, resulting in 97 sets of scores for the ACRS and 97 sets of scores for the META.

**Data analysis**

**Study I**

To prepare the data for analysis, the audio-recorded material from the think aloud protocol were transcribed first. The video recordings were then viewed, through which observations, such as a participant’s actions, affective expressions, and interactions with the digital device as well as happenings on the screen were noted beside the transcripts to provide context. Repeated reviews of the video recordings allowed further formulation of memos about reflections, impressions, and questions related to the observations. Memos also included clarifications whether the participant is actually thinking out loud or drawing other persons present (research or possibly a spouse or partner) in a dialog. Altogether, the transcripts, notes, and memos constituted the data that was used for the narrative analysis.
The narrative analysis [155, 177, 178] involved an iterative approach to the configuration of stories about engagement in occupations made unique through involvement of digital technology. A temporal ordering of observations and other verbalizations indicating time was done, after which significant events were identified by establishing plots and elements that contribute to plots. Several significant events were identified, on which vignettes were formulated to provide context for and understanding of the stories. A few significant events were omitted when data from the think aloud protocol and observations did not provide adequate grounding for events and emerging plots. To ensure their authenticity and relevance, the vignettes were re-explored by reviewing the stories against the original data. The stories were constructed and reconstructed in an iterative process in order to illustrate key findings within a context in dialog with theory [177, 179].

Having ten participants in the study involved mining ten sets of data for significant events. Part of the analysis was finding commonalities in the stories [179]; that is, finding common or similar features, such as occupations performed, contexts, immediate social environments, and participants’ experiences with digital technology. Yet, it was also important to preserve the integrity of each narrative [179]. Thus, data elements from five participants were represented in stories that narrated the distinct features of engagement in digital technology-mediated occupations.

**Study II**

The preparation of the data for analysis involved transcribing the interviews from the audio recordings. The recordings were then reviewed to gain an understanding about participant responses and interactions. Notes and highlights were made on the transcripts about ideas that people agreed or disagreed on or had in common. Next, the data was analyzed using qualitative content analysis [180], and an inductive approach was taken to analyze manifest content [181]. From each transcript, meaning units were formed and coded in English, from which subcategories were formulated. Subcategories from all transcripts were combined and discussed among the authors for further abstracting and interpreting, after which categories and a theme were formulated. The categories and the theme were formulated and reformulated in an iterative process involving reviews of the original data, grouping and regrouping subcategories, abstracting, and interpreting. The analysis also included phrasing findings in a simple, comprehensible language [182].
Study III

The initial step in data analysis was to create qualitative case descriptions (Figure 1) [160]. First, a temporal ordering of data in each case was done, which resulted in a timeline of the tailored intervention process. Second, diagrams were drawn based on the information in each case [160]. The initial diagrams facilitated the identification of patterns, insights, or points of interest within each case, which further resulted in the creation of other diagrams. Patterns could be a set of strategies done together or in sequence. Points of interest could be about goals identified, occupations chosen, and strategies undertaken. Diagramming was a recursive process and involved reviewing original data in several iterations. The diagrams, together with a timeline of the tailored intervention process, responses on instruments, and the final interview notes, comprised the qualitative case descriptions. Nine qualitative case descriptions were included in the cross-case synthesis.

A cross-case synthesis was then used in order to compare and combine within-case patterns and points of interest across the nine cases [160]. A case-based approach was employed to ensure that the entirety of each case was preserved. This meant that besides analyzing case descriptions, the original data was also reviewed in a recursive process in order to create a structure for the findings. As the cases were unique, patterns and points of interest were compared based on features such as dimensions such as frequency of DT use, goals set, and participants’ accounts of practice between visits.
1. Timeline

<table>
<thead>
<tr>
<th>Timeline</th>
<th>Group information</th>
<th>Individual information</th>
<th>Collaborative process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weeks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2018-MM-DD</td>
<td>Information (group)</td>
<td>Information (individual) &amp; consent</td>
<td>Consent given on same day</td>
</tr>
<tr>
<td></td>
<td>Battery of instruments</td>
<td>Observation</td>
<td>Dialog based on Interest Checklist and data collected Planning</td>
</tr>
<tr>
<td>2019-MM-DD</td>
<td>Tailoring</td>
<td>Tailoring</td>
<td>Tailoring</td>
</tr>
<tr>
<td>2018-MM-DD</td>
<td>Follow-up</td>
<td>Further tailoring</td>
<td>Last follow-up and final interview</td>
</tr>
</tbody>
</table>

2. Diagram 1

- **Assess needs and interests**
  - Background info
  - UCLA Loneliness Scale
  - Social network
  - Interest checklist (dialog)
  - Observation
- **Reflect on assessment findings**
  - First meetings involved much time for getting to know each other and building trustful relationship
  - Possible goals
    - To provide assistance in managing technology
    - To search for information safely
    - To be more independent and feel more secure in using computer
- **Plan and discuss suggestions with P**
  - Summarized observations and results from interest checklist and made plans based on discussion
  - Goal: to read newspaper online
  - Activity 1. Preparing to read online (managing technology) and reading online.
  - Activity 2. Discussing safety in online searches for information
- **Tailor activity**
  - Activity 1.
    - Discussed possibility of having separate user account, instead of having one which requires assistance to login. Negotiated own account for Participant (P).
    - Configured new user account on computer while discussing options - decided on no login for P, no changes on spouse's user settings.
    - Configured visual settings - bigger pointer and text size, simple background, while discussing options with P.
    - Provided feedback during follow-up meetings. P doing well.
    - Visual cues for keys (zooming, arrow keys) on a post-it.
    - Let P practice and give feedback.
- **Monitor and modify activity**
  - Activity 1.
    - Provided information about configuring contrast since P has visual concerns. Showed various options and let P decide. Showed spouse where to configure if they want to change the setting another time.
    - Provided feedback during follow-up meetings. P doing well.
    - Important also the P is aware whether information come from reliable sources.
- **Reflect on person responses (dialogs and observations)**
  - Achieved P's goals. P was satisfied. Discontinued at the end of the project period.
  - Activity 1.
    - Reading newspaper was a big part of his day, important for P to manage newspaper reading as independently as possible.
- **Discontinue meetings**
  - Activity 2.
    - Recurring dialogs about safety of info source
Figure 1. Example of a qualitative case description
Study IV

Rasch analysis was chosen as it provided a statistical framework for the unidimensionality of an attribute (e.g., an ability to do something) that can be represented in hierarchy of estimates of that attribute (e.g., more ability and less ability) [183]. This representation comes in form of a multifaceted Rasch measurement (MFRM) model. In Study IV, the MFRM model could illustrate a linear relationship between the instrument items (facet 1) in relation to the occupations performed or technologies used (facet 2) and the persons who were scored on the instruments (facet 3). In addition, Rasch analysis has been previously used in the development and validation of the ACRS and META [135, 141].

Two separate MFRM models – one MFRM model of the ACRS and one MFRM model of the META – were generated on the FACETS 3.83.0 program [184] based on the scores on respective instruments. Each MFRM model was generated from resulting estimates or measures expressed in log-odds units or logits for each item, occupation, technology, and person after Rasch analysis iterations. Higher logits for an item, occupation, or technology indicates that that item, occupation, or technology are more difficult to perform, while lower logits for facet 1 or 2 indicates that that item, occupation, or technology are easier to perform. Higher logits for a person indicate that the person has more ability, while lower logits for a person indicate that the person has less ability.

The MFRM models were first examined for internal validity and reliability. First, internal validity was examined through the goodness-of-fit of items, which indicated how well the scores on the items fit in the respective measurement systems. Items should have both mean square value (MnSq) which less than or equal to +1.4 [185, 186] and standardized z value (z) of less than +2.0 [185] to demonstrate goodness-of-fit. Higher values for the MnSq and z indicate more randomness and less predictability of the data [185]. The fit of items to their respective models was the most important in an examination of internal validity as items that were found difficult in this sample should be expected to be just as difficult in observations of other people [186]. All items that did not demonstrate goodness-of-fit were removed in succeeding iterations until the remaining items had fit values within the criterion. Next, reliability was examined through the standard error of measurement (SE) for each of the estimates and a separation ratio (G) [187]. SE indicated how close the estimates for each facet are to its true measures, and the criterion for an acceptable SE was set to a value less than or equal to +0.30. A separation ratio of one facet could indicate how well that facet had been spread out in distinct levels along the linear scale by the other two facets [187]. The distinct levels could be computed with the formula, \((4G+1)/3\) [187].
The estimates for each item, occupation, and technology could then show in respective hierarchies which items, occupations, and technologies were more difficult and which were easier. Estimates for each person could place participants in an ability hierarchy from the person who are most able to the person who is least able.

The association between the ability to perform digital technology-mediated occupations and ability to manage digital technology was then examined by conducting a Spearman correlation test on the person ability estimates on the ACRS and the META. The resulting Spearman correlation coefficient ($r$) and significance level ($p$) were noted. A conventional interpretation of the correlation coefficient (0.00–0.10= negligible correlation, 0.10–0.39=weak correlation, 0.40–0.69=moderate correlation, 0.70–0.89=strong correlation, 0.90–1.00=very strong correlation) was used to analyze the resulting $r$ [188]. A correlation between the abilities would also give an indication about the concurrent validity between the ACRS and the META.

**Ethical considerations**

The studies received approval subsequent to ethical vettings by the Regional ethical review board in Umeå, Sweden in Dnr 2013-418-31Ö for Studies I, II, and IV, and Dnr 2017/50-31 for Study III.

To ensure protection of participants' dignity, integrity, right to self-determination, privacy, and confidentiality of personal information [189], procedures were undertaken. Participants were informed about respective study objectives and procedures, data management, confidentiality of information, and their right to discontinue participation. Informed consent was acquired from all participants prior to data collection. In Study III, the tailoring process was conducted in a collaborative manner such that decisions about interventions were made by the participants after dialogs. Furthermore, Studies I, III, and IV involved the observation of people while performing digital-technology mediated occupations. Additional ethical considerations regarding the observations are described below.

*Study I*

In the data collection and analysis of filmed observations in Study I, the actual content that participants entered in the digital devices was not the focus of the study and were part of the analysis. Information keyed in personal code generators were generally obscured in video recordings, but video recordings that happen to capture personal data were excluded from the analysis.
**Study III**
In the choice of occupations to focus on during the tailored intervention process, it was emphasized to participants that occupations relating to personal economy and finances were to be excluded from tailoring. The researcher also looked away when personal codes were keyed in the devices.

**Study IV**
Just as in Study III, it was made clear to participants that occupations relating to personal economy and finances were to be excluded from observations. When participants entered personal identity numbers or a password on a device, the researcher looked away and covered the camera lens to avoid observing personal data. If logging into the device was necessary to begin the occupation, the video recording was delayed until the login step was completed. Moreover, data collection sessions were concluded with a summary of what was observed to provide the participants an opportunity to reflect on their occupational performances and management of technologies. Issues which participants raised about their performances were discussed, and participants were reassured that the results from the observations were intended to bring to light the challenges encountered by many older adults oftentimes because of the complexity of digital technologies. This was emphasized to participants who expressed any form of dissatisfaction over one’s performance or articulated one’s inability as an explanation for not completing chosen occupations.
Results

The aim of this thesis is to develop knowledge to support older adults’ social participation through engagement in occupations mediated by digital technology. Through the studies included in this thesis, developing knowledge entailed an exploration of older adults’ engagement in occupations mediated by digital technology (Study I), their contexts surrounding social participation (Study II), tailoring supports for engagement (Study III), and instruments to measure outcomes after tailored interventions (Study IV).

Engagement in digital technology-mediated occupations

The objective in Study I was to explore how older adults engage in and situate digital technology-mediated occupations in daily life. The findings were abridged into three stories about how older adults engaged in and situated digital technology-mediated occupations in daily life – being alone, belonging together, and becoming alone together.

In the first story about being alone, one woman used digital technologies at home in a cluster of occupations such as paying for bills and using a social networking site. In this story, she established rules for herself through her routines and online conduct, defined what she valued and found satisfying, and at the same time, refined her sense of worth and identity. Being alone did not mean feeling alone. Rather, it illustrated that by having time for oneself, a person could make use of one’s time constructively by reflecting on one’s engagement in digital technology-mediated occupations. Reflecting could lead to agency or the ability to make choices and intentionally effect one’s participation [190].

In the second story about belonging together, a married couple engaged in co-occupations both online with a computer and offline in the kitchen. They expressed that computer issues did not matter so much as they were not online often. By belonging together, they provided each other a sense of coherence, had the possibility to cultivate a unique insight into each other’s identities and values, and developed aspects of their own identities so that they relate to and support the other. Belonging together meant being part of a social group and a context while creating shared but personalized meanings by engaging in digital technology-mediated occupations together [191, 192].

In the third story about becoming alone together, two cohabiting persons took turns using the computer in activities that were new to them, trying to learn on their own and to support each other’s attempts. One person managed to follow through as intended, but the other chose to discontinue the occupation. The story
reflected negotiation of the need to be alone in order to exert choice and control in their attempt to master novel occupations and the need to be together to create shared meanings through occupations. Becoming alone together signified becoming [193, 194] and was manifested as a movement from doing things by alone in order to master novel occupations to sharing access to resources and supporting each other.

The configuration of these stories led to further reflections that could potentially affect occupational therapists’ views about occupations. In the first story where performance of a cluster of occupations was described, the reflection was about whether there was need to delineate when engagement in one occupation ended and another started. In the second story, it was about whether co-occupations could occur in shared virtual spaces. In the final story, the reflection was about whether successful engagement in occupations should be based on the achievement of a goal or the process with the choice to do or not to do. The stories coincide with the understanding of occupation as doing, being, belonging, and becoming.

**Contexts surrounding social participation**

In Study II, the objective was to explore older adults’ perceptions about contexts surrounding their social participation in a digital society. The findings were encapsulated into the theme – the juxtaposition of narrowing offline social networks and expanding digital opportunities for social participation. It revealed older adults’ perceptions of reduced opportunities for social interaction and their concomitant acknowledgement of the increasing potential to use digital technologies in daily life. The theme was formed from three categories – experiencing conditions for social participation in a state of flux, perceiving drawbacks of urbanization on social participation, and welcoming digital technology that facilitates daily and community life.

First, the discussions related to experiencing conditions for social participation in a state of flux dealt with changing social conditions such as spaces, networks, and codes. They elucidated that over time, social and activity spaces had changed and even expanded online, and that participation in communities and organizations had faltered for varying reasons. They also discussed that while they were satisfied with their social networks regardless of the size, there were social codes, such as dress codes, that influence their engagement in social meetings. Technology had also influenced social opportunities; television, as they exemplified, had taken out the spontaneity in social meetings. They reported prioritizing time for doing preferred activities, such as home improvement, but they also expressed wanting to contribute to others.
Second, in discussions related to *perceiving drawbacks of urbanization on social participation*, older adults opined that by concentrating services in urban areas, key social players are drawn away from their rural communities. Furthermore, interest in computers among young community members had contributed to a decline in local social activities. They expressed feeling insecure with receding contact with service providers due to relocation of public service offices (e.g., post office) and complicated automated telephone access to healthcare professionals. Driving was therefore seen as freedom, as it allowed them to do occupations, meet people, join social gatherings and courses, and access healthcare.

Last, discussions on *welcoming digital technology that facilitates daily and community life* pertained to older adults’ preference for technologies that could satisfy their needs for personal contact and security. They acknowledged their need to keep informed about events and the vast access to information from home but stressed how relevant or irrelevant available information was to them. They expressed a desire for online services and activities that could be accessed from home, but their interest in and use of technology were weighed against usability and data protection issues.

**Tailoring supports for engagement**

The objective of Study III was to explore how tailoring to support of older adults’ engagement in digital technology-mediated occupations could be schematized. The findings were synthesized in a tailoring scheme to support engagement in digital technology-mediated occupations (Figure 2). Tailoring interventions require collaboration with the older person, significant others and available support in his or her context, and other professionals. The scheme consisted of six steps on how to tailor supports, with *Build rapport and trust* extending over the entire process. Rapport and trust could be built up by discussing participants’ preferences, suggesting options, and carrying out their choices. It also entailed taking breaks from performing digital technology-mediated occupations in order to listen actively while older persons talked about matters that were important to them.

First, to *Identify interests, needs, or goals*, participants were asked about their interests and about digital technologies that they considered important or would like to try out. These questions provided information about their interests, needs, and goals. In the second step, *Facilitate exploration of possible relevance*, the use of digital tools (e.g., a search engine on a web browser on a tablet) was demonstrated and explained at the same time. Participants were encouraged to interact directly with digital tools and to discuss the demonstration in relation to their interests.
Identify interests, needs, or goals

Facilitate exploration of possible relevance

Facilitate or support:
- Clarity of the desired occupation
- Awareness of the virtual environment
- Compatibility between preferences and configuration
- Navigation and manipulation

Facilitate conditions leading to experience of self-efficacy and agency

Facilitate awareness of available support

Support routine development

Figure 2. Proposed tailoring scheme to support engagement in digital technology-mediated occupations
The third step was to Facilitate or support: (a) clarity of the desired occupation, (b) awareness of the virtual environment, (c) compatibility between preferences and configuration, and (d) navigation and manipulation. Facilitating clarity of the desired occupation was seen as appropriate for participants who were observed to have difficulty following through the occupation. That is, when they hesitated in initiating what they intended to do or continuing on to the next step, or when they clicked reflexively until they found themselves doing other occupations. To make the occupation manageable, they were encouraged to clarify and set boundaries for the occupation they desired to engage in. Next, awareness of the virtual environment was facilitated for participants who were observed to have difficulty finding information that they desired. The extent of the virtual environment was explained to them so that they could gain an understanding where relevant information, tools, and commands could be located. Participants were also made aware that virtual objects could be hidden, for example, under other windows or advertisements. Compatibility between preferences and configuration was supported for participants who were unable to see or locate virtual objects or to understand information. To make the digital technology more accessible and perceptible, modifications to the physical environment (e.g., furniture arrangement) and virtual environments (e.g., visual configurations) were suggested and tested until they matched the participants’ preferences. Supporting navigation and manipulation was for participants who were observed to have difficulty moving and using the tools within the virtual environment. To make the technology more useable for their occupations, they were given instructions or cues and trained to navigate in the virtual environment and to select and use virtual objects.

The fourth step, facilitate conditions leading to experience of self-efficacy and agency, involved dialogs about alternative actions or solutions to support informed choices about their occupations as well as dialogs about strategies that participants preferred or found helpful. These dialogs were held so that participants could experience a sense of being able to do their desired occupations successfully and/or to do something intentionally to affect successful performance.

In the fifth step, facilitate awareness of available support, discussions about available support (e.g., family, paid professional, library services, online information, fora with experienced older users in Sweden) were initiated to encourage continued engagement even when experiencing difficulties. The last

23 Virtual environment in this thesis refers to a representation of a space accessible through a graphic interface (e.g., screen) that is relevant to the performance of a DT-mediated occupation.

24 Virtual objects in this paper refers to a representation of objects, such as information, tools, and commands, within the virtual environment accessible through a graphic interface (e.g., screen) that is relevant to the performance of a DT-mediated occupation.
step, *support routine development*, was about encouraging participants to involve significant others in their occupations, to practice their occupations alone, and to reflect on their engagement.

**Instruments to measure outcomes**

In Study IV, the objective was to investigate how older adults’ ability to perform digital technology-mediated occupations and ability to manage digital technology could be measured, and to examine the association between these two abilities. The results corresponding to the Rasch measurement models are presented first, followed by results from examining association between ability to perform digital technology-mediated occupations and ability to manage digital technology.

**ACRS**

Since participants chose their own occupations to perform, there were occupations that were performed by only one participant and occupations that were performed by several participants. Thus 45 different occupations were performed and observed. Rasch statistics in the MFRM model of the ACRS are presented in Table 10.

<table>
<thead>
<tr>
<th>ACRS facets</th>
<th>Item</th>
<th>Occupation</th>
<th>Person</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>37</td>
<td>45</td>
<td>25</td>
</tr>
<tr>
<td>n with $MnSq \leq 1.4$ and $z &lt; 2.0$</td>
<td>18</td>
<td>43</td>
<td>22</td>
</tr>
<tr>
<td>Estimate, maximum (logits)</td>
<td>0.91</td>
<td>3.10</td>
<td>5.41</td>
</tr>
<tr>
<td>Estimate, minimum (logits)</td>
<td>$-1.68$</td>
<td>$-4.95$</td>
<td>$-2.05$</td>
</tr>
<tr>
<td>$SE_a$, maximum (logits)</td>
<td>0.20</td>
<td>1.84</td>
<td>0.50</td>
</tr>
<tr>
<td>$SE_a$, minimum (logits)</td>
<td>0.13</td>
<td>0.10</td>
<td>0.12</td>
</tr>
<tr>
<td>n with $SE &lt; 0.30$</td>
<td>18</td>
<td>30</td>
<td>24</td>
</tr>
<tr>
<td>Separation ratio without extremes$^b$</td>
<td>4.47</td>
<td>4.24</td>
<td>8.30</td>
</tr>
</tbody>
</table>

$^a$ Standard error of measurement associated with each measure.

$^b$ Extremes were minimum values associated to an occupation that had low observed counts (i.e., not many occasions that the particular occupation was scored) or was given a score of 4.

The final MFRM model of the ACRS was comprised of 18 items that demonstrated goodness-of-fit, with item difficulty estimates that ranged from $+0.91$ to $-1.68$ logits with $SE$ lower than 0.30 for all estimates (Table 11). The separation ratio for items was 4.47 which indicated six levels of item difficulty.
Table 11. Final estimates for items that demonstrated goodness-of-fit in the ACRS, arranged by difficulty

<table>
<thead>
<tr>
<th>Item</th>
<th>Estimate</th>
<th>SE</th>
<th>MnSq</th>
<th>z</th>
<th>MnSq</th>
<th>z</th>
</tr>
</thead>
<tbody>
<tr>
<td>AD-4</td>
<td>0.91</td>
<td>0.15</td>
<td>1.23</td>
<td>1.4</td>
<td>1.04</td>
<td>0.2</td>
</tr>
<tr>
<td>TO-4</td>
<td>0.73</td>
<td>0.13</td>
<td>0.98</td>
<td>0.0</td>
<td>0.86</td>
<td>-0.6</td>
</tr>
<tr>
<td>VE-2</td>
<td>0.54</td>
<td>0.14</td>
<td>1.13</td>
<td>0.9</td>
<td>1.21</td>
<td>0.9</td>
</tr>
<tr>
<td>VE-3</td>
<td>0.54</td>
<td>0.13</td>
<td>0.81</td>
<td>-1.3</td>
<td>0.79</td>
<td>-0.9</td>
</tr>
<tr>
<td>VE-8</td>
<td>0.52</td>
<td>0.14</td>
<td>0.85</td>
<td>-1.0</td>
<td>0.71</td>
<td>-1.3</td>
</tr>
<tr>
<td>TC-3</td>
<td>0.42</td>
<td>0.13</td>
<td>1.01</td>
<td>0.1</td>
<td>0.97</td>
<td>0.0</td>
</tr>
<tr>
<td>AD-2</td>
<td>0.39</td>
<td>0.13</td>
<td>0.79</td>
<td>-1.4</td>
<td>0.79</td>
<td>0.0</td>
</tr>
<tr>
<td>TO-2</td>
<td>0.20</td>
<td>0.13</td>
<td>0.70</td>
<td>-2.2</td>
<td>0.76</td>
<td>-1.0</td>
</tr>
<tr>
<td>AD-1</td>
<td>0.11</td>
<td>0.13</td>
<td>0.70</td>
<td>-2.2</td>
<td>0.79</td>
<td>-0.8</td>
</tr>
<tr>
<td>TC-2</td>
<td>0.11</td>
<td>0.13</td>
<td>0.80</td>
<td>-1.4</td>
<td>0.77</td>
<td>-0.9</td>
</tr>
<tr>
<td>VE-7</td>
<td>0.09</td>
<td>0.19</td>
<td>1.38</td>
<td>1.9</td>
<td>1.46</td>
<td>1.3</td>
</tr>
<tr>
<td>TO-5</td>
<td>-0.03</td>
<td>0.13</td>
<td>0.68</td>
<td>-2.4</td>
<td>0.96</td>
<td>0.0</td>
</tr>
<tr>
<td>TO-3</td>
<td>-0.08</td>
<td>0.14</td>
<td>1.04</td>
<td>0.2</td>
<td>0.91</td>
<td>-0.2</td>
</tr>
<tr>
<td>VE-4</td>
<td>-0.14</td>
<td>0.13</td>
<td>0.92</td>
<td>-0.5</td>
<td>0.72</td>
<td>-1.0</td>
</tr>
<tr>
<td>VE-6</td>
<td>-0.71</td>
<td>0.17</td>
<td>1.10</td>
<td>0.6</td>
<td>1.20</td>
<td>0.6</td>
</tr>
<tr>
<td>PE-10</td>
<td>-0.81</td>
<td>0.16</td>
<td>1.16</td>
<td>0.9</td>
<td>1.71</td>
<td>1.7</td>
</tr>
<tr>
<td>TO-1</td>
<td>-1.10</td>
<td>0.17</td>
<td>1.25</td>
<td>1.3</td>
<td>1.48</td>
<td>1.1</td>
</tr>
<tr>
<td>PE-9</td>
<td>-1.68</td>
<td>0.20</td>
<td>0.87</td>
<td>-0.5</td>
<td>2.02</td>
<td>1.5</td>
</tr>
</tbody>
</table>

* Estimates and SE in logits

Occupation difficulty estimates ranged from +3.10 to −4.95 logits. Fifteen occupation difficulty estimates had SE values greater than 0.30. Two occupations did not demonstrate goodness-of-fit to the model of the ACRS (with MnSq > 1.4 and z ≥ 2). The separation ratio for occupations excluding extremes was 4.24 which indicated 6 levels of occupation difficulty.

Person ability measures had a range from +5.41 to −2.05 logits. Only one person ability measure was associated with SE greater than 0.30. All except three persons demonstrated goodness-of-fit to the MFRM model of the ACRS. The separation ratio for persons was 8.30, which indicated 11 levels of person ability. Figure 3 shows the hierarchy of estimates for person ability and occupation difficulty in the MFRM model of the ACRS.
<table>
<thead>
<tr>
<th>Measure (logits)</th>
<th>Person (n=25)</th>
<th>Occupation</th>
<th>Rating Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td></td>
<td></td>
<td>(4)</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Save/send webpage</td>
<td>Search topic &amp; save</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Upload photo on web</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Make appointment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Copy/move photo to other device</td>
<td>Save photo from email</td>
<td>Edit &amp; save photo</td>
</tr>
<tr>
<td></td>
<td>Send photo to contact</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Make document with photo/text</td>
<td>Play app-based game</td>
<td>Show photos</td>
</tr>
<tr>
<td></td>
<td>Search &amp; play music</td>
<td>Search government info</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Search weather &amp; send</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Search product &amp; save in card</td>
<td>Print photo</td>
<td>Search local activities</td>
</tr>
<tr>
<td></td>
<td>Make document with photo/text</td>
<td>Play app-based game</td>
<td>Show photos</td>
</tr>
<tr>
<td></td>
<td>Search &amp; play music</td>
<td>Search government info</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Search weather &amp; send</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Search product &amp; save in card</td>
<td>Print photo</td>
<td>Search local activities</td>
</tr>
<tr>
<td></td>
<td>Make document with photo/text</td>
<td>Play app-based game</td>
<td>Show photos</td>
</tr>
<tr>
<td></td>
<td>Search weather &amp; send</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Search product &amp; save in card</td>
<td>Print photo</td>
<td>Search local activities</td>
</tr>
<tr>
<td></td>
<td>Make document with photo/text</td>
<td>Play app-based game</td>
<td>Show photos</td>
</tr>
<tr>
<td></td>
<td>Search weather &amp; send</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Search product &amp; save in card</td>
<td>Print photo</td>
<td>Search local activities</td>
</tr>
<tr>
<td></td>
<td>Make document with photo/text</td>
<td>Play app-based game</td>
<td>Show photos</td>
</tr>
<tr>
<td></td>
<td>Search weather &amp; send</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Search product &amp; save in card</td>
<td>Print photo</td>
<td>Search local activities</td>
</tr>
<tr>
<td></td>
<td>Make document with photo/text</td>
<td>Play app-based game</td>
<td>Show photos</td>
</tr>
<tr>
<td></td>
<td>Search weather &amp; send</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Search product &amp; save in card</td>
<td>Print photo</td>
<td>Search local activities</td>
</tr>
<tr>
<td></td>
<td>Make document with photo/text</td>
<td>Play app-based game</td>
<td>Show photos</td>
</tr>
</tbody>
</table>

Figure 3. Linear representation of person ability measures and occupation difficulty estimates in the Multifaceted Rasch model of the ACRS
META
From the digital technologies that participants chose use, there were technologies that were used by only one participant and technologies that were performed by several participants. Thirty-seven different digital technologies – a combination of devices and apps – were used and observed. Rasch statistics in the MFRM model of the META are presented in Table 12.

Table 12. Rasch statistics for the META

<table>
<thead>
<tr>
<th>META facets</th>
<th>Item</th>
<th>Technology</th>
<th>Person</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>11</td>
<td>37</td>
<td>25</td>
</tr>
<tr>
<td>n with (MnSq \leq 1.4) and (z &lt; 2.0)</td>
<td>10a</td>
<td>36</td>
<td>24</td>
</tr>
<tr>
<td>Measure, maximum (logits)</td>
<td>1.20</td>
<td>1.65</td>
<td>3.09</td>
</tr>
<tr>
<td>Measure, minimum (logits)</td>
<td>−2.16</td>
<td>−4.42</td>
<td>−0.75</td>
</tr>
<tr>
<td>(SE_b), maximum (logits)</td>
<td>0.71</td>
<td>1.83</td>
<td>0.47</td>
</tr>
<tr>
<td>(SE_b), minimum (logits)</td>
<td>0.12</td>
<td>0.10</td>
<td>0.20</td>
</tr>
<tr>
<td>n with (SE \leq 0.30)</td>
<td>7</td>
<td>11</td>
<td>16</td>
</tr>
<tr>
<td>Separation ratio excluding extremes</td>
<td>3.59</td>
<td>1.91</td>
<td>3.37</td>
</tr>
</tbody>
</table>

\(\text{a }\) One item was not assigned goodness-of-fit statistics because there were no scores associated with it (i.e., not at all observed).

\(\text{b }\) Standard error of measurement associated with each measure.

\(\text{c }\) Extremes were minimum values associated to a technology that had low observed counts (i.e., not many occasions that the particular technology was scored) or was given a score of 4.

In the MFRM model of the META, ten items demonstrated goodness-of-fit, with item difficulty estimates that ranged from +1.20 to −2.16 logits. Three item estimates were associated with \(SE > 0.30\) (Table 13). The separation ratio for items was 3.59 which indicated five levels of item difficulty.
### Table 13. Estimates for items in the META, arranged by difficulty

<table>
<thead>
<tr>
<th>Item</th>
<th>Estimate</th>
<th>SEa</th>
<th>MnSq</th>
<th>z</th>
<th>MnSq</th>
<th>z</th>
</tr>
</thead>
<tbody>
<tr>
<td>A10</td>
<td>Notice information and respond adequately</td>
<td>1.20</td>
<td>0.12</td>
<td>0.87</td>
<td>−0.9</td>
<td>0.81</td>
</tr>
<tr>
<td>A5</td>
<td>Choose correct button or command</td>
<td>0.86</td>
<td>0.12</td>
<td>0.82</td>
<td>−1.3</td>
<td>0.78</td>
</tr>
<tr>
<td>A7</td>
<td>Use appropriate force, tempo, and precision</td>
<td>0.62</td>
<td>0.12</td>
<td>0.98</td>
<td>−0.1</td>
<td>1.06</td>
</tr>
<tr>
<td>A2</td>
<td>Identify and select services and functions within a technology</td>
<td>0.45</td>
<td>0.14</td>
<td>1.20</td>
<td>1.4</td>
<td>1.18</td>
</tr>
<tr>
<td>A3</td>
<td>Perform steps and actions in logical sequence</td>
<td>0.37</td>
<td>0.13</td>
<td>0.85</td>
<td>−0.9</td>
<td>0.85</td>
</tr>
<tr>
<td>A8</td>
<td>Coordinate different parts of the technology</td>
<td>0.35</td>
<td>0.35</td>
<td>0.40</td>
<td>−2.0</td>
<td>0.37</td>
</tr>
<tr>
<td>A4</td>
<td>Manage series of numbers/letters</td>
<td>0.30</td>
<td>0.18</td>
<td>1.23</td>
<td>1.2</td>
<td>1.38</td>
</tr>
<tr>
<td>A9</td>
<td>Coordinate the technology with another technology without physical contact</td>
<td>−0.22</td>
<td>0.20</td>
<td>0.85</td>
<td>−0.6</td>
<td>1.07</td>
</tr>
<tr>
<td>A6</td>
<td>Turn a button or knob in correct direction and position</td>
<td>−1.78</td>
<td>0.71</td>
<td>0.27</td>
<td>−0.9</td>
<td>0.17</td>
</tr>
<tr>
<td>A1</td>
<td>Identify and select/separate technologies</td>
<td>−2.16</td>
<td>0.31</td>
<td>1.05</td>
<td>0.2</td>
<td>1.81</td>
</tr>
</tbody>
</table>

The difficulty estimates for 37 technology combinations ranged from +1.65 to −4.42 logits. Twenty-six estimates were associated with $SE > 0.30$. One technology did not demonstrate goodness-of-fit to the MFRM model of the META, with $MnSq > 1.4$ and $z ≥ 2$. The separation ratio for technologies excluding extremes was 1.91 which suggested that there are at least 2 levels of technology difficulty.

Person ability measures ranged from +3.09 to −0.75 logits with nine measures associated with $SE$ greater than 0.30. All except one person demonstrated goodness-of-fit to the MFRM model of the META. The separation ratio for persons was 3.37, which suggested at least 4 levels of person ability. Figure 4 shows the hierarchy of estimates for person ability and technology difficulty in the MFRM model of the META.
<table>
<thead>
<tr>
<th>Measure (logits)</th>
<th>Person (n=25)</th>
<th>Technology (device and app)</th>
<th>Rating Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td></td>
<td></td>
<td>(4)</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>TabletPlayservice&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TabletCamera&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>StationarycomputerPhoto&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>LaptoptoUSB&lt;sup&gt;b&lt;/sup&gt;</td>
<td>StationarycomputerMaintenance&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Tablettebook&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>SmartphonePhoto</td>
<td>TabletGame&lt;sup&gt;b&lt;/sup&gt;</td>
<td>TabletteNews&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>SmartphonetoLaptop</td>
<td>SmartphoneCamera</td>
<td>LaptopCalendar&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>LaptoptoPrinter</td>
<td>LaptopEmail</td>
<td>SmartphoneWeb</td>
</tr>
<tr>
<td>0</td>
<td>SmartphoneTextTV&lt;sup&gt;c&lt;/sup&gt;</td>
<td>TVTextTV&lt;sup&gt;c&lt;/sup&gt;</td>
<td>TabletMessage&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>LaptopWeb</td>
<td>LaptopWordprocess</td>
<td>SmartphoneMessage&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>TabletteMail&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>StationarycomputerMusic&lt;sup&gt;c&lt;/sup&gt;</td>
<td>Tabletsocialnetworksite&lt;sup&gt;c&lt;/sup&gt;</td>
<td>TablettePlayservice (instructions)&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>−1</td>
<td>SmartphoneSocialnetworksite&lt;sup&gt;c&lt;/sup&gt;</td>
<td>TVRegularprogram&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SmartphoneNews&lt;sup&gt;c&lt;/sup&gt;</td>
<td>SmartphonePollen&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>−2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>−3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> Technology whose difficulty estimate had $MnSp>1.4$ and $z≥2$.

<sup>b</sup> Technology whose difficulty estimate had $SE>0.30$.

<sup>c</sup> Technologies in parentheses were considered “extreme” as they were observed only in one occasion or had maximum scores.

Figure 4. Linear representation of person measures and technology estimates in the Multifaceted Rasch model of the META.
Correlation between person abilities

Spearman’s correlation coefficient $r$ was equal to 0.825 ($p<0.01$). This result indicated significant and strong positive correlation between the ability to perform digital technology-mediated occupations and ability to manage digital technology. That is, older adults who have easily perform digital technology-mediated occupations are more likely to easily manage technology and vice versa. Additionally, older adults who have difficulty performing digital technology-mediated occupations are more likely to have difficulty managing technology and vice versa. This correlation is illustrated in Figure 5. This result also shows that preliminary evidence that the ACRS and META demonstrate concurrent validity.

Figure 5. Scatterplot of ACRS and META person ability measures
Discussion

This section is divided into three subsections: (1) a discussion of the results from Studies I-IV in relation to each other, (2) a discussion of the methodologies used in the studies, and (3) an overall discussion of the thesis that includes implications to research, and occupational therapy practice and education.

Results discussion

The insights gained about older adults’ engagement in digital technology-mediated occupations (Study I) and their contexts (Study II) provided the foundations for tailoring supports for older adults’ occupational engagement involving digital technology (Study III) and for considering measurements related to engagement in occupations mediated by digital technology (Study IV). The overall aim of this thesis is to develop knowledge to support older adults’ social participation through engagement in occupations mediated by digital technology. In what way could an occupational perspective facilitate understanding of the knowledge acquired from the findings and results? How could this understanding be applied to support older persons’ social participation and occupational engagement involving digital technologies? From the perspective that engagement and social participation are outcomes of transactions between the people, environment, and occupation, several related and recurring ideas emerged, namely: situatedness and relevance, agency and self-efficacy, uniqueness of engagement, and supporting participation.

Situatedness and relevance

Participation is a result of transactions between the person, occupation, and environment [72]. The findings in Studies I and II reinforce that participation and engagement (a positive experience of participation) are indeed situated. In Study II, a further exploration of older adults’ contexts illuminated their perceptions of narrowing non-digital social networks and expanding digital opportunities for social participation. A finding specific to digital technology was that while interest and curiosity were considered important for frequent technology use, digital technologies were acceptable as long as they provided satisfactory experiences and support was available. This finding was regarded highly in planning tailored intervention strategies in Study III.

Participation becomes relevant when people can connect with its situatedness in daily life. Relevance could be described as the congruity between the person’s goals, needs, or values and perceived usefulness of something (be it an occupation, digital technology, information, or tool) [27]. Perceived usefulness
refers to the extent to which a person believes that this particular something would improve an aspect of his or her life [109]. An interest could be considered relevant as it is something that concerns or draws the attention of a person because of a goal, need, or value. Preference could likewise be related to relevance as it denotes a practical advantage a person gives to one alternative over another. Relevance in the form of occupations that are meaningful or preferred has been previously reported [95, 102].

In Study I, relevance was brought to light in all three stories, as preference for specific digital tools in particular occupations or as interests that guided them in their choice of activities to perform. It also manifested as the extent of participants’ inclination to use a digital tool in relation to its utility to meet personal needs, such as enhancing the feeling of belonging to each other and their community. In Study II, relevance was illuminated as prioritizing time for preferred occupations, preferring media that provided local news and community information, and viewing the car as important as it facilitated engagement in many occupations. Additionally, relevance was expressed as a preference for technologies that enhanced their sense of security and addressed their needs for personal contact and continued living at home. Thus, it was pertinent that the identification of interests, needs, or goals in Study III became the starting point of the tailored intervention process. Goals were set based on person’s interests and how they desired their occupations to be. **Facilitating exploration of the possible relevance** of digital tools was considered an important step as finding relevance could be a step towards deriving purpose or meaning in digital technology-mediated occupations. Lastly in Study IV, measurements commenced from the choice of occupations or technologies that were relevant to the participants.

**Agency and self-efficacy**

Agency refers to acts done intentionally [195] through choices to effect one’s engagement in occupations [190 p. 78]. Enacting agency conveys intentionality, which entails monitoring one’s actions or behavior pattern and reflecting on one’s performance of occupations [195, 196]. Actions that are intentional are often governed by goals, needs, or values as well as moral reasoning and standards of social conduct [195].

Agency was first noted in Study I. In the story about being alone, the participant reflected on her engagement in digital technology-mediated occupations which enabled her to establish rules for herself through routines and online conduct, and define what she valued and found satisfying. In Study II, participants talked about social standards, such as dress codes, that affected their choices to engage in social activities. In Study III, the step support routine development was also
about agency as routines refer to organizing occupations and can be developed by repetitive doing and reflecting on the doing [197].

Belief in one’s ability to exert control over oneself and one’s environment, or efficacy, is a foundation of agency [195]. Within technology acceptance models, self-efficacy refers to the sense of being able to use a technology successfully [109, 110]. Self-efficacy is a contributing factor for older adults to accept technology and adopt it in daily life. That is, an older person who feels he or she is able to use a particular digital technology is more likely to adopt that technology in daily life. Self-efficacy is positively associated to perceived ease of use, perceived usefulness, and usage behavior [109].

Self-efficacy was manifested in the story about becoming alone together in Study I. Participants tried to perform activities that were new to them with a sense that they could exert control over the digital environment. Even for the participant who did not manage to achieve what he intended, choosing to discontinue an occupation on that occasion to perform it again during a more suitable occasion reflected a degree of efficacy. Discontinuing occupations for later performance was also observed in Study IV. These findings guided reasoning in tailoring supports. In particular, facilitating conditions leading to experience of self-efficacy and agency during the tailored intervention process in Study III entailed initiating dialogs to support informed choices about participants’ occupations as well as dialogs to reflect about strategies that participants preferred or found helpful.

**Uniqueness of engagements**

As people are unique and have diverse abilities to participate in occupations [14], how they engage in occupations are unique. This was clearly seen from all studies in this thesis. Insights gained in Studies I and II about older adults’ experiences of digital technology use in various occupations, were considered in the tailoring of supports (III) and in the measurement of abilities (Study IV). To exemplify, in Study I, unique behaviors that were presented in the stories were not framed as difficulties or mistakes but instead as negotiating or refining of one’s identity as well as finding and experiencing meaning. Unique behaviors observed in Study III were also not seen as difficulties or mistakes but rather considered more of an openness to finding supports in order to achieve one’s goals leading to refinement of one’s identity or finding meaning in life. From a co-constitution perspective, unexpected uses of digital technology can be seen as a way for older persons to negotiate a meaningful space for technology in their lives [78]. Furthermore, participants in Study IV were asked how they usually performed their chosen occupation or use their chosen technology. By doing so, it was acknowledged that occupations are unique to the person who is doing it [5, 14] and not based on the
rater’s own expectations on how the occupation should be performed or how the technology should be used.

Furthermore, the uniqueness of engagement in occupations clustered together and co-occupations with significant others first observed in Study I had also guided reasoning the choice of tailored intervention strategies in Study III and further reflection regarding measurement in Study IV.

*Occupations clustered together* refers to occupations often performed in sequence or in rapid shifts, which raises the question, when does one occupation end and another occupation start? This can result from using digital devices that allow a person to perform various, though not necessarily related, occupations and to discontinue or resume use anytime (Study I). In this instance, the convergence of different functions and services in one digital device affords the device’s use in various occupations [56]. In Studies I, III, and IV, participants were observed to perform occupations clustered together that allowed them to shift between occupations easily. It made observation of one specific occupation challenging, especially in measurement, which brought about the question of a need to delineate when engagement in one occupation ends and engagement in another occupation starts. Potentially, occupations clustered together could also make tailoring of supports challenging if the boundaries of the occupations are not made clear. In Study III, *facilitating clarity of the occupation* could be a step to delineate occupations in clusters.

*Co-occupations* with significant others are shared activities in which two or more persons interactively shape each other through reciprocal motor and emotional responses and shared intentions [198, 199]. In Study I, two participants engaged in co-occupations which provided them a sense of coherence and belonging and refined their identities so that they could relate to and support each other. This was an important finding which guided reasoning in Study III to use interactive demonstrations in the step *facilitate exploration of possible relevance* as well as encourage participants to involve significant others to *support routine development*.

**Supporting participation**

Study III resulted in a scheme for tailoring supports for older adults’ engagement in digital technology-mediated occupations. The tailored strategies in this scheme corresponded with concepts in occupational therapy such as building rapport [5, 27, 169, 200], setting goals [5, 27], finding relevance [27], creating conditions that support agency and efficacy [195], and developing routines [27, 201]. The strategies also coincided with concepts in technology acceptance models, such as
perceived usefulness, perceived ease of use, compatibility, self-efficacy, and support as a facilitating condition [109, 110].

What was not clearly defined from discourses in Studies I and II was whether participation dealt with engaging in occupations or using technology. In the examination of these constructs in Study IV, it was revealed that the ability to perform digital technology-mediated occupations was positively correlated at a significant level to the ability to manage digital technologies. This result does not give an indication of the synonymy of these two constructs. However, it indicates that persons who are able to perform digital technology-mediated occupations are more likely to manage digital technologies and vice versa. It further implies that knowledge about one ability would provide an understanding about the other ability.

**Methodological discussion**

**Trustworthiness**

Efforts were made into order to contribute to the trustworthiness of Studies I-III. Various aspects of trustworthiness – credibility, dependability, transferability, and confirmability – are discussed below.

**Credibility**

Credibility pertains to the confidence in how well the data and methods address the intended focus of the study [180]. One way to ensure credibility is to make decisions about participant selection, and data collection that are relevant to the focus of each study. Based on the specific foci in Studies I-III, it was clear that invitations to participate in respective studies should be directed towards older adults in Northern Sweden. Recruitment among older adults was an expected challenge as it has been noted by other authors [202, 203]. A factor contributing additionally to this challenge is the focus on digital technologies, as many older adults particularly in rural localities are non- and infrequent users of the digital technologies [12, 106]. However, the purposive sampling in Studies I-III and snowball sampling in Study II in several localities helped ensure that the studies had a wide representation of participants – geographically and age-wise – and participants who could provide information to addressed the study foci. With regards to the distribution of participants according to sex, the dominance of women in the studies correspond to statistics on the older population [30] ensuring representativeness.

Credibility was also considered in data collection and analysis. In Study I, the dialogic nature of verbalizations was first considered a concern as it diverged
from the think aloud protocol. Those instances where the participant discussed with the researcher or a spouse or partner actually portrayed a more authentic engagement and provided more insight on the situatedness of occupations. Thus, dialogs were not discouraged. In Study II, two moderators were present in all focus group interviews. Discussions between moderators were held between interviews to identify areas that needed more focus in succeeding interviews. In Study III, the data collection tools and materials (battery of instruments, observations, fieldnotes, memos, and interview) provided sources of information for triangulation. Peer debriefing during data collection and analysis was done for Studies I-III [204]. In addition, researchers who were experienced in the respective methods were involved in Studies I and II [153].

Still another way to ensure credibility is to check how well the results cover the data [180]. In Study I, all authors were involved in analysis and had access to the transcriptions and memos. Additionally, vignettes and quotations from the data were used to support the stories. Credibility in Study II was reinforced by parallel coding, consensus discussions between authors, and authors belonging to various professions. Representative quotations from transcribed texts were also provided for each subcategory. In Study III, there were also discussions on the findings among authors who belonged to healthcare and technology professions. Likewise, texts from the fieldnotes or responses in the final interview were provided to support each step.

**Dependability**

Dependability pertains to the stability and consistency of the research findings [205]. Dependability in Studies I-III was supported through author discussions in data collection and analysis as well as recursive reviews of raw data and preceding analyses. In Study II where two interviews were held at intervals for each focus group, dialogs within the research team provided a check of the data and areas to be explored further. Additionally, giving a summary of topics discussed during the first interviews provided a continuity in the discussions in the focus groups. In Study III which was also conducted over an extended period, fieldnotes were reviewed prior to visits, and a summary of the intervention process was given before the final interview.

**Transferability**

Transferability refers to the extent to which findings can be transferred to other settings or groups [180]. Attempts to support transferability judgment was done in Studies I-III through thick descriptions of the participants, participant recruitment and selection, and data collection and analysis [205]. Additionally, findings were presented with representative quotations and texts from collected data.
**Confirmability**

Confirmability refers to the extent to which the findings could be confirmed by other researchers and deals with ensuring that the interpretations of findings are derived from the data [205]. Respondent validation [204], through summaries of discussions in focus groups provided by the assistant moderator in Study II and intervention process summaries given during the final interviews in Study III, was also used. Peer debriefing was also done was done for Studies I-III.

**Validity, reliability, and generalizability**

Quality in Study IV is discussed in terms of validity, reliability, and generalizability.

**Validity**

Construct validity refers to the degree to which an instrument measures what it claims to measure [183]. In Rasch analysis, internal validity pertains to the degree to which items fit together to measure a single dimension or construct. In Study IV, internal validity of both instruments was tested. Eighteen out of 37 ACRS items and 10 out of 11 META items demonstrated goodness-of-fit to MFRM models of respective instruments. In light of the small sample size, these results only provide preliminary evidence of internal validity. Thus, studies with bigger samples should be done to further test internal validity. However, since the study objective was to investigate how older adults’ ability to perform digital technology-mediated occupations and ability to manage digital technology could be measured, then these results still provide information about respective constructs and how the abilities could be measured.

**Reliability**

Reliability pertains to the degree to which results can be reproduced when research is repeated under the same conditions. To ensure reliability in scoring using the ACRS and the META, films were reviewed repeatedly in order to confirm scores, and an experienced scorer was consulted in observations that were not easy to score in the META. Reliability indices, such as the standard error of measurement and separation ratio, were also examined in the Rasch analyses. There were item and technology difficulty estimates in the META, occupation difficulty estimates in the ACRS, and person ability measures in both instruments that were associated with SE greater than the set criterion. This could be attributable to the low counts of observations due to the small sample size (n=25) and diversity of occupations and technologies the participants could choose from. However, a sample size range of 16 to 36 persons would have contributed to the stability of item or person estimates at ±1 logit with a 95% confidence interval.
Nevertheless, a bigger sample size would have contributed to better reliability indices in the MFRM models of the instruments.

**Generalizability**

In Study IV, the results provided preliminary evidence of validity and reliability of the instruments on a sample of older persons as well as evidence of a significant correlation between the abilities measured. A bigger sample of older adults is needed to provide a stronger foundation for a sound generalizability of the results.

**Overall discussion**

A transactional perspective [23, 72] puts into focus the older person engaging in occupations and participating in society while situated in a context. In the context of old age, social participation is regarded as important. However, older adults perceive that there are fewer opportunities for social interactions as well as fewer facilities and services, thereby curtailing their social participation. On the other hand, digital technologies are perceived to augment social opportunities and access to services, as long as these technologies provide satisfactory experiences for the older adult and supports necessary to manage technologies are available. These findings from Study II have been reported in other studies [95, 96, 102]. Older adults prefer and consider it important to have non-digital alternatives in service provision, particularly healthcare, so that they do not become marginalized or socially excluded. This is important when designing and implementing digitalized services as there is a risk of social exclusion when older persons are unable to access digitalized services and opportunities [16].

Social participation mediated by digital technology could be a means for older adults to negotiate and refine their identities and to find and experience meaning in daily life. Finding meaning through engagement in occupations using digital technologies has been earlier reported [102]. Through social participation mediated by digital technology, older adults have the possibility to do what they want to do, become who they want to be, and continue to live longer at home. Similar findings have been presented in studies on use of digital technologies among older persons [96, 207].

Social participation among older adults entails a transaction between the person, occupation, and environment. Thus, facilitating a satisfactory experience of social participation in a digitalized society requires understanding what is relevant to the person, creating conditions to promote the older person’s agency and self-efficacy as well as acknowledging that engagement in occupations are unique and situated in the contexts of daily life.
Implications to research

Based from experience in the studies, collaboration with older persons, support networks, and professionals from health and technical disciplines can broaden researchers’ perspectives and skills and expand the applications of the results of research. The findings from Studies I-IV give rise to a call for research in the following areas:

Implementation studies

Interventions to promote social participation among older adults need to be implemented. An exploration of the impact of existing technologies and existing community services on older persons’ social participation could provide an understanding how existing resources could be utilized to promote social participation. Furthermore, the development of apps and other technologies should involve older adults in co-creation or participatory action research. Older adults should also be involved in identifying outcomes following interventions. Besides the measurement of traditional outcomes, such as participation, health and well-being indices, other outcomes such as agency, goal achievement, satisfaction, and relative mastery could be worth exploring. In order to reach vulnerable groups in communities, a community approach could be used. Additionally, the scheme to tailor supports in various settings should be tested.

As there are differences in life expectancies and living conditions as well as effects of social participation between older men and women, it is relevant to under how social participation mediated by digital technology are experienced for older men and women. Research could extend to implementing various community-based programs to promote social participation.

Instrument development and validation

The ACRS and the META have shown potential to measure the ability to perform occupations mediated by digital technology and the ability to manage digital technology. Studies using larger samples are needed to test the psychometric properties of the instruments.

There is also need to develop new and validate existing instruments that assess other constructs relating to digital technology. Since technological developments persist, assessment instrument that are focused on particular digital technologies (or parts of technologies) are vulnerable to persisting technological developments. Thus, constructs should not be technology-dependent and careful thought must be given to developing items.
Implications to occupational therapy practice

Occupational therapists’ concerns related to digitalization include occupational therapists’ digital literacy, knowledge within occupational therapy accessibility and resources, and older clients’ goals and needs. (Table 1). This thesis contributes with several understandings relating to these concerns (order has changed due to proximity to study results):

Older clients’ goals and needs

- Participation that is mediated by digital technology deals with negotiating and refining identities, in addition to, finding and experiencing meaning in daily life (Study I). To address the concern older adults’ disinterest in technology and perceived non-functionality of computer goals [121], it is important to help older adults to identify the relevance of digital technology in their lives (Studies I-III).

- A digital technology is perceived by older adults to be useful in enhancing social opportunities, accessing services and giving a feeling of security when the technology provides a satisfactory experience for the older adult and support is available (Study II).

Knowledge within occupational therapy

- While it is acknowledged that it needs to be tested in various settings, the scheme for tailoring supports (Study III) contributes to the knowledge about ways on how to support older adults’ engagement in occupations mediated by digital technology. Since aspects in the scheme correspond to several existing concepts with occupational therapy, it can be viewed an innovation of occupational therapy models in response to digitalization of societies.

- While it is also acknowledged that further validation of the ACRS and the META are needed (Study IV), the ACRS and the META have the potential to measure pertinent outcomes, namely the ability to perform digital technology mediated occupations and the ability to manage digital technology. Furthermore, the knowledge about the positive correlation between these two abilities provide occupational therapists the choice to focus on either occupational performance or technology management.

Occupational therapists’ digital literacy

In relation to the third concern, digital competence is a competence required for occupational therapists in Sweden [130]. This thesis proposes that though it is important for occupational therapists to develop digital competence, occupational therapists working with older adults should strive to develop digital literacy, for the reasons that:
Acknowledging that participation is situated and finding relevance do not only require knowledge and skills, but also an openness, curiosity, and respect to explore how older adults’ participation is embedded in their contexts.

Second, creating conditions that support agency and self-efficacy also does not require just knowledge and skills, but also a readiness to reflect and an intentionality in order to be a credible agent of change. Furthermore, reflection can contribute to clarify and motivate one’s ethical choices.

Last, recognizing uniqueness in engagement requires, besides knowledge and skills, creativity and flexibility in order to adapt occupations and technology in consideration for older adults’ needs, preferences, and goals. Creativity could be supported through collaborations with other professionals.

Furthermore, collaboration with other professionals would help develop one’s digital literacy and enhance practice.

Accessibility and resources
Occupational therapists in Sweden should also have the competence to ensure that resources available are utilized in a sustainable manner – economically, socially, and ecologically [130]. To support older adults in their social participation with the help of digital technologies does not mean the latest devices need to be acquired by organizations. From a co-constitution perspective [78], occupational therapists should utilize the technologies that older adults already have at home (Study III). It is also important to consider that older adults have existing skills sets based on the technologies that they use at home. Additionally, there are existing resources in the community, such as libraries, innovation labs, and organizations. Communities can be change agents [103], and person-centered occupational therapy programs in the community can promote social participation among older adults.

Implications to occupational therapy education
Entry-level occupational therapists should have substantial knowledge, skills, and attitudes in order to address local health needs [208]. As digitalization has been acknowledged to support health promotion and disease prevention; to improve the accessibility, quality, and affordability of health services; and to reinforce the efforts towards sustainable development [40, 50, 61], developing digital competence among occupational therapy students worldwide becomes imperative. Educational programs should incorporate digital tools in students’ search for information, analysis and synthesis of knowledge, and communication. Additionally, educational programs should offer opportunities for occupational
students to develop digital tools and services for client groups in collaboration with students from technical programs or professionals with technical backgrounds. Students should be encouraged to explore and familiarize themselves with online occupations [131], observe digital technology-mediated occupations [132], and participate in competence development networks and fora [128, 131]. Since results from the Studies I-IV were based on data collected in Northern Sweden and were not tested in other contexts, occupational therapy educators should collaborate with researchers in order to test the knowledge presented in this thesis in local contexts.
Conclusions

The findings from the studies contribute to the knowledge for occupational therapists to support older adults’ social participation through engagement in occupations mediated by digital technology.

- Older adults’ participation in digital technology-mediated occupations deals with the negotiation and refinement of identities as well as finding and experiencing meaning in daily life. There is potential for older adults to do what they would like to do and become who they want to be through participation in digital technology-mediated occupations.

- Social interaction is viewed as important in old age, but fewer opportunities for social interactions, facilities, and services – particularly in rural communities – can reduce social participation. Digital technologies are perceived to augment social opportunities and access to services as well as provide a feeling of security as long as they provide satisfactory experiences for the older adult and support for digital technologies are available. Facilitating satisfactory use of digital technologies could support older adults’ social participation and engagement in occupations that they find relevant in their lives, which subsequently, might enable them to live longer at home.

- A scheme for tailoring interventions augments the knowledge on how occupational therapists could support older adults in their engagement in digital technology-mediated occupations and participation in society. Tailoring interventions require collaboration with other professionals.

- Ability to perform in digital technology-mediated occupations is positively correlated to the ability to manage digital technology. Awareness of an older person’s ability to engage in digital technology-mediated occupations will give insight on his or her ability to manage digital technology and vice versa.
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Though I acknowledge the efforts of hardworking creators of digital technologies, I must state that I am neither affiliated with, nor authorized, sponsored, or approved by companies owning the trademarks for technologies aforementioned in this thesis. Nor am I endorsing any specific digital product or service named or alluded to in this thesis.

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