

Co-creation Methods: Informing Technology Solutions for Older Adults

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Abstract. With the demographic shift towards an aging population, there is an increasing need for and interest in technologies that address challenges associated with aging. The AGE-WELL Network of Centres of Excellence is developing and building capacity in researchers and partners affiliated with the network and beyond to co-create solutions with older adults and other stakeholders. In this paper three projects using different approaches to co-creation are explored: community-based participatory research, integrated knowledge translation, and transdisciplinary working. The projects span different focus areas and disciplines: (1) a seniors' affordable housing redevelopment evaluation; (2) a realist review of middle-aged and older adults and the digital divide; and (3) development of rehabilitation software for older adults' cognitive health. Based on these projects, opportunities for enriching the research process through co-creation methods are highlighted. In addition, factors to consider when choosing and implementing co-creation methods, such as the type of research project, level of project development, ethical issues, and resources available will be discussed. We conclude the paper with a call for researchers using co-creation in technology development to evaluate the impact of such approaches.

Keywords: Community-based participatory research · Co-creation · Integrated knowledge translation · Transdisciplinary working · Aging · Technology · Innovation

1 Introduction

With the demographic shift towards an aging population, there is an increasing need for and interest in technologies that address challenges associated with aging. In Canada adults 65 and older account for over 16% of the population; this proportion is expected to rise to 20% by 2024 [1]. A similar trend is seen globally. To meet the needs and expectations of older adults, it is imperative that technologies currently being developed are relevant, usable, appealing, and are suited to the everyday lives of older adults. This could be supported by using co-creation research approaches.

AGE-WELL NCE, a pan-Canadian research network on aging and technology is focused on developing innovative methods and technologies to support adults to age

well. This transdisciplinary network of experts derives from several disciplines and professions, including gerontology, neuropsychology, health sciences, engineering, software development and more. Together they are working on a number of research initiatives focused on engaging older adults in research; one of which is a scoping review to better understand transdisciplinary working practices, in particular, the barriers, facilitators and added value to enhance research outcomes and positive transformation in real world contexts [2]. Another is looking at how best to support meaningful engagement of older adults throughout the research process. These are amongst a number of the key projects that are working towards evaluating, improving, and innovating opportunities to develop technological solutions that are relevant and accessible for integration into older adults' everyday lives. Through this work, AGE-WELL NCE is developing and building capacity in researchers and partners affiliated with the network and beyond to co-create solutions with older adults [3].

Developing technologically innovative solutions *with* rather than *for* older adults requires a degree of visioning and understanding of co-creation that extends beyond revealing and collecting accounts of older people's experiences. The authors, affiliated with AGE-WELL NCE, contribute to building capacity for innovative ways of working with older adults based on their experiences with co-creation research approaches utilized prior to and within the context of AGE-WELL NCE.

Co-creation is often associated with product development in the business literature. A number of seminal works articulate co-creation in the business management literature for value creation, such as Ramaswamy and Ozcan [4] who define co-creation as: "joint creation and evolution of value *with stakeholding individuals*, intensified and enacted through *platforms of engagements*, virtualized and emergent from *ecosystems of capabilities*, and actualized and embodied in *domains of experiences*, expanding *wealth-welfare-wellbeing*" (italics in original, p. 14). Co-creation articulated in business, as defined here, focuses on value creation for the company and the consumer. However, the value that researchers are seeking to gain through co-creation in their work may be somewhat different (for example, academic publications versus increased profits). The critical element that crosses the boundary from business and marketing to academic research and innovation is that all stakeholders have goals being met through the process. Moving beyond user input, into collaboration, towards what Gibbons [5] refers to as 'context-sensitive' or 'Mode 2' science, where the boundaries between science and society are blurred and the resulting interaction is producing new questions, methods, knowledge sources, and solutions that serve a broader objective.

With this broad view of co-creation - context-sensitive, collaborative, socially engaged, and interactive - we reflect on our experiences with research related to older adults using the following co-creation approaches: community-based participatory research, integrated knowledge translation, and transdisciplinary working. Each of these approaches has overlapping or complimentary components, yet stem from different disciplinary bases or paradigms. Community-based participatory research, often associated with social sciences, involves stakeholders as research participants and producers, working toward the co-creation of applied solutions. Integrated knowledge translation derives from health sciences and emphasizes early stakeholder engagement and an iterative synthesis of available evidence prior to implementation. Finally, transdisciplinary

working emphasizes the engagement of all relevant disciplines, sectors, and stakeholders in a collaborative process that transcends disciplinary boundaries to contribute to the development of innovative solutions to real world problems.

In this paper, these approaches are examined through three illustrative research projects, detailing the theoretical and practical aspects of the identified approaches. The projects span different focus areas and disciplines: (1) a seniors' affordable housing redevelopment evaluation (community-based participatory research); (2) a realist review of middle-aged and older adults' access to and use of information and communication technology (integrated knowledge translation); and (3) development of rehabilitation software for older adults' cognitive health (transdisciplinary working).

Based on these projects, we illustrate opportunities for enriching the research process through co-creation methods rather than provide instructions on how to conduct a co-creation project. We do explore factors to consider when choosing and implementing co-creation methods, such as the type of research project, level of project development, ethical issues, and resources available. We conclude the paper with a call for researchers using co-creation in technology development to evaluate the impact of such approaches.

2 The Projects and Co-creation Approaches

Three research projects that explore the nuances, complexities, and value of co-creation approaches, including key features and strategies that can be applied in research and development for technology solutions for older adults are described and discussed.

2.1 Community-Based Participatory Research

This project explored the experiences of older adults transitioning from a deteriorating 3-storey low-rise affordable seniors' housing community into two newly built 16-storey high-rise towers. Of particular focus was the integration of seniors' sense-of-place and strategies for rebuilding the 'feeling of community' among the original tenants of the low-rise building. This project applied a number of strategies for user engagement, including photovoice sessions, experiential group walks, and mapping exercises with service providers and older adults, which incorporated action-oriented components.

Traditionally, the planning process for housing redevelopment initiatives has taken a top-down approach with the regeneration professional acting as the expert and decision-maker [6]. However, this approach has been challenged as it largely excludes the knowledge of local residents, which is important to ensure that any change reflects the community needs, resources, and assets [7]. Resident insight has been identified as crucial for the success of redevelopment projects [8]. Despite having extensive neighbourhood context and place experience, residents of a community, particularly older people, are seldom engaged in regeneration initiatives [9]. Since the new trend is to make cities more age-friendly, involving older people in the creation and maintenance of such environments is key for producing urban environments that facilitate health and well-being [9]. Achieving this objective will require a shift from developing urban places *for* older people to building meaningful environments *with* and *by* seniors [9].

To prioritise the perspectives of older adults, a community-based participatory research study design was chosen to provide seniors with the ‘space’ and platform to have their voice heard and generate collaborative dialogue (with the researchers). This research approach brought together researchers and community stakeholders (e.g., older adults, developers, municipal government, housing society, and service providers) to formulate equitable partnerships for the co-creation of research with the shared goal of improving community health and social outcomes and knowledge production and exchange [10, 11]. To engender community-based participatory research principles in the research process, experiential group walks, participatory mapping exercises, and photovoice sessions with service providers and older adults were conducted. These methods were selected because they offered community stakeholders a nuanced mechanism to share lived experiences via voice and vision triggering their emotional ties to place, observations of their physical surroundings, and ideas generated through mutual knowledge exchange [12].

For instance, photovoice is a visual method [13] grounded in qualitative participatory research principles that is used as a way of exploring personal experiences of a particular phenomenon [7]. First established by Wang and Burris, this method has been used to facilitate community engagement while simultaneously producing powerful images that have the potential to influence policy agendas in the areas of public health, education, and social work [14]. During photovoice sessions, participants can take or direct the taking of photographic images to illustrate their everyday experiences, engage in visual narrative interviews, and work with each other and researchers to discuss related themes and potential actions [15]. For participants, this process provided an avenue to visually portray experiences, and share and discuss personal knowledge about issues that may be challenging to express through words alone [13]. Photovoice was selected for this study because it provided a space that empowered older people to share stories of place through creative and collaborative photo taking and analysis. Critical to the success of the photovoice process in this project was the relationships established by the researcher with the older adults. The trust and bond developed over the course of the project supported the open and creative sharing of their experiences.

Meanwhile, participatory mapping is a research process that provides the opportunity to create a tangible display of people, places, and experiences that make up a community [16]. Over the last decades, participatory mapping was used by various disciplines for an array of different research and development purposes, such as land use, crime prevention, education, and health [17]. Similarly, experiential group walks involved researchers walking with older adults and stakeholders to explore the neighborhood context, enabling participants to be the expert, highlighting (in real-time) meaningful places, public spaces, and activities in their local environment [18]. Experiential walks enabled the research team to access older peoples’ attitudes and knowledge, and further understand the types of relationships they maintained within their community [19]. Experiential group walks and mapping exercises offered visual cues to help participants describe their relationship to place; such triggers were captured via audio recording and photography [12]. Visual methods [20] provided opportunities for understanding unique cultural and social nuances of participants’ everyday lives. One of the challenges faced in this method was the mobility of the participants, not all of the older adults were

interested in or able to do an extended walk. The researchers accommodated the needs of the groups by shorter routes and frequent breaks. In addition part of the process involved identifying the spaces and places important to the older adults on physical maps of their community.

Findings from this project are rich, qualitative, and contextualized themes that capture a number of issues that are important to older adults for aging well in the right place. For instance, the theme of ‘positive sense-of-place’ identified key areas that planners could support: access to physical activities; safe and familiar spaces for social activities; convenient proximity to community resources; and maintaining a sense of control over their lives [12]. Stakeholder participants identified ideal characteristics of affordable housing as: adaptable, well-appointed, affordable, and centrally located. And recommended an inclusive design and development process similar to the co-creation approaches described in this paper.

From these, and further findings of the project, multiple applied and academic outputs have been generated. The former included working with the housing provider and residents in the development of an implementation and sustainability plan for the new affordable housing towers to support social interaction and sense of community; supporting the commitment to action of the housing provider, municipality, and developers to work collaboratively with residents; and recommendations for the municipality and housing society to consider for housing policies and future developments. For the tenants of the towers involvement in the project has supported their community engagement in the new building and as sense of validation for their expertise and experience. They can see themselves in all of the activities, impacts, and the research process. For academic outputs, the team has presented at national and international conferences on the methods and project findings. In addition, the relationships established with the different stakeholder groups (including older adults) have generated further collaborations, initiatives, and user engagement in other research projects.

2.2 Integrated Knowledge Translation

This project set out to explore the digital divide for middle-aged and older adults concerning their access to and use of information and communication technologies (ICTs). The project began in collaboration with a community partner organization, which contributed to the development of the research questions and other research decisions. In addition, two World Cafés were conducted with stakeholder groups to guide, inform, and contribute to the data analysis, synthesis, and knowledge mobilization.

Given the potential of digital technologies to support aging well, we were interested in exploring the current state of what is often referred to as the ‘digital divide’. The digital divide was understood in the project as the unequal and/or inequitable access to the benefits of ICTs due to limitations of motivation, physical access, or capacity to use [21]. The integrated knowledge translation project included a realist synthesis review, two World Café events, and dissemination materials.

Integrated knowledge translation refers to the integrated, collaborative working of academic researchers with knowledge users throughout the entire research process to produce evidence that is useful and relevant to practice and to moving science forward

[22–24]. Critical to understanding integrated knowledge translation is the concept of knowledge translation itself. There are over 100 terms used for this concept, such as knowledge exchange, knowledge mobilization, and evidence-based practice, depending on the context and discipline [25]. For the purposes of this project, we used the Canadian Institutes of Health Research definition:

“A dynamic and iterative process that includes synthesis, dissemination, exchange and ethically-sound application of knowledge to improve the health of Canadians, provide more effective health services and products and strengthen the health care system. This process takes place within a complex system of interactions between researchers and knowledge users which may vary in intensity, complexity and level of engagement depending on the nature of the research and the findings as well as the needs of the particular knowledge user” [24].

In keeping with this definition of knowledge translation, we sought to synthesize available literature published over the last decade on the current state of the digital divide as it pertains to middle-aged and older adults. The integrated portion of the knowledge translation process speaks to the degree of engagement of stakeholders in the process. We chose an integrated knowledge translation approach to ensure that: relevant questions were asked; channels for dissemination developed; and relevant knowledge and expertise beyond what was available through academia were included in the knowledge synthesis. The three primary strategies used in the project included: collaborating with community partners; conducting two World Café dialogue events with diverse community members and stakeholders; and producing accessible dissemination materials.

The first strategy of community partner collaboration involved team meetings with our partner to develop and refine our research goal and objectives prior to submitting the grant application for funding. Subsequently, we worked closely with our partner to refine our knowledge synthesis questions. The research objectives were to identify: knowledge gaps relating to middle-aged and older adults access to and use of ICTs; and recommendations for policy, service, and research to address the digital divide. One challenge we faced was that our primary contact at the community partner organization left the position approximately two-thirds into the project period, and her successor did not prioritize the research partnerships to the same degree. This is a perennial challenge to collaborative research initiatives. Given the probability for this to occur memorandums of understanding [26] should be established prior to the project being undertaken and having multiple community partners can reduce the impact. For this project other community partners were involved to differing degrees such that the project was able to move forward successfully.

The second strategy used was the World Café. World Cafés are often used as a participatory method for effective dialogue, knowledge exchange, and relationship building. Through the application of this approach, Fouche and Light [27] found “the impetus on collective discoveries enables the harnessing of resourcefulness and a sense of hope, while the drive towards collaborative learning allows for equitable and collective participation” (p. 46). As such, these interactive Cafés were an excellent approach for the project such that interdisciplinary and inter-sectoral groups were empowered to engage in dialogue that focused on a topic of shared interest (i.e., the use of ICTs by middle-aged and older adults). The aims of the World Café events were twofold: to capture the tacit knowledge of others’ experiences of ICT use by middle-aged and older

adults; and to develop interest and engagement to support the knowledge mobilization of the findings.

The World Café method incorporates the following five key components: a comfortable setting, a welcome and introduction, small group rounds, questions, and large group discussion. World Cafés are meant to foster open and relaxed dialogue, which is in part achieved through emulating a casual café-like setting where participants will be seated around tables with a café ambiance and refreshments [28]. Our two events were organized differently, with the first focused on generating understandings and meanings of the digital divide through everyday lived experiences and the second focused more on identifying gaps, validation of the findings, and knowledge mobilization.

At the first World Café, 6 tables of 5–7 participants (older adults, service providers, and researchers with vested interest in the area) were set up with one facilitator and one note-taker. Paper and pens were provided to enable creative expressions or hand written notes to supplement the verbal dialogue. The second event was held after the synthesis was completed as a workshop prior to gerontology conference with two tables of 5–7 participants. Participants included researchers and service providers focused on older adults and technology. We found that the World Café method worked particularly well for the first event, allowing for rich exploratory conversations with the variety of stakeholders involved. It was essential to have older adults' voices at the tables to contextualize their experiences of using ICTs, which provided real world examples of what was emerging in the literature. Participants at the events appreciated to networking and learning opportunity that the World Café afforded, as well as an opportunity to hear different experiences and strategies for exploring and addressing these issues.

Central to this integrated knowledge translation project was producing accessible outputs to share with participants, stakeholders, and the broader community. The research synthesis and World Café dialogue informed the development of a final report which was designed and written to be engaging and useful for policy makers, service providers, and other researchers [see 29]. The report describes the key messages, in brief these are: (1) There continues to be a gap in ICT access and use between younger cohorts that have grown up with the technology (generation X and younger) and the next previous cohort (baby boomers and older); (2) Tailored, relevant, and ongoing training and support can help to increase access; (3) Ageist representations of older adults and ICT use serves to perpetuate the digital divide; and, (4) Usable and accessible design can enhance use of ICTs as some adults experience physical challenges such as declines in vision and hearing, and increased arthritis in their hands. Highlighting the key findings, or points of interest, to the front of the report with details of the research near the end.

This report was shared at an academic gerontology conference, a multidisciplinary knowledge mobilization event hosted by the funding organization, and is available online. Additionally, a manuscript for peer-reviewed publication is in progress in order to reach the wider academic community.

The integrated knowledge translation approach ensured the project explored a relevant question that had practical implications. The context and specific examples provided through the first World Café event enriched the project report, making it more useful and user friendly for policy and service provision, while the second validated the work, increased knowledge sharing, and identified gaps to address in future research.

An additional benefit of the engagement process was building new relationships for future collaborative research initiatives.

2.3 Transdisciplinary Working

This project focused on developing rehabilitation software for older adults with the goal of improving the cognitive health of seniors. The software was created in collaboration with seniors, neuropsychologists, scientists, and music teachers and directly targets cognitive functions while inspiring high engagement and motivation. The research team adapted the content of the software based on the guidance of the different stakeholders.

A transdisciplinary scoping review completed by the AGE-WELL transdisciplinary working research team identified three features of transdisciplinarity: (1) is of mutual benefit for science and society; (2) is an interactive process involving co-production and integration of research and experiential knowledge; and (3) includes implementation or mobilization to create real-world impact [2].

The rehabilitation software development project applied a transdisciplinary approach in order to develop their curriculum of music training for children into one that would support the cognitive health of older adults [30]. Thus, experts from several fields (music, teaching, psychology, clinic practice, neuroscience, programming, engineering) and older adults were brought together. The technology undertook a unique approach to brain fitness by using musical training to improve different cognitive skills, such as language, reading, attention, memory, self-esteem, and intelligence. The software integrated scientific findings related to the effects of musical training, benefits of various teaching methods, and cognitive aging. Emerging evidence indicates that music training is an effective method to counteract age-related declines in cognitive ability suggesting that engaging in musical activity late into life may preserve cognitive functioning in old age [31].

The research development panel for the project identified that having a transdisciplinary team was the reason for successfully creating musical training software to improve different brain skills. Throughout the project, each skill and diverse expertise of the transdisciplinary team was critical. However, transdisciplinary working was not straightforward and many difficulties were encountered due to the diversity of the team. The difficulties experienced are reflected in the transdisciplinary literature. An initial challenge to overcome was language difference, as team members often used the same words for different purposes as specified by their discipline. This created many misunderstandings and was overcome by developing a common vocabulary, an issue confronted in other transdisciplinary contexts [32–34]. Another challenging element was the lack of understanding of the scope and limitations of different disciplines [35–37]. Thus, a fluid communication channel was critical to ensuring clear understandings of what each team member could contribute. Finally, coordinating the schedules, restrictions, and productivity of a large, dispersed, transdisciplinary team was challenging as members were dependent on each other for different aspects of the work. In this case, as in other transdisciplinary projects [33, 35, 37, 38], effective facilitation, sufficient resources, and good management skills were necessary to keep the project moving forward. The challenges were outweighed by the productivity of the team [37, 39–42];

developing scientific and social understanding of a real world problems [39, 41, 42]; and the production of better solutions to the complex problem at hand [32, 35, 37, 38, 43, 44].

3 Discussion

As with any type of research, a number of factors contribute to determining the ‘optimal’ research approach. As a result, decisions to adopt a co-creation approach, such as the research paradigm and methods, are dependent upon the suitability of the project for co-creation and available resources. As illustrated by the small sample of diverse projects and co-creation approaches described here, there are a variety of strategies to support active engagement of older adults and other stakeholders.

Prior to beginning a co-creation project, researchers and innovators need to identify if, when, and how, older adults and other stakeholders should be involved in their research and development projects. For example, basic scientific research may not lend itself to active knowledge user engagement, but could benefit from advisory group input. In the context of aging and technology for supporting older adults to age well, most, if not all projects, will benefit from active and integrated user engagement. In addition, the project needs to be of interest to older adults. If the project or the involvement strategy does not meet the interest or needs of older adults their participation and engagement will be challenging.

For projects that are under development, an integrated knowledge translation approach is a viable option for ensuring relevant questions are being addressed and the full range of available evidence and knowledge is synthesized toward developing the solutions or answers to those questions. This approach can serve to address and support the engagement of older adults. If an older adult is engaged at the research question phase, they are bound to find the experience more fulfilling. For projects that have a community partner interested in solving a problem specific to their community, using community-based participatory research can create actionable outputs the community partner can implement and build on with further research and development. Community organizations serving older adults can often facilitate the active engagement of older adults in projects that they are serving their members. Finally, taking a transdisciplinary working approach is well suited to projects that seek to address complex problems and create social and scientific change.

To assist in determining ‘if and when’ co-creation approaches should be used, research teams could identify their stage of product development. There are a number of Product Readiness Scales that can assist with identifying the stage of development a project has attained (see [45]). This can inform the type of user engagement and feedback needed for moving the project forward. AGE-WELL NCE is developing a product readiness level framework to be utilized by AGE-WELL and other aging and technology projects that has integrated concepts of user engagement and transdisciplinary working.

In addition to the suitability of the project, determining the resources available and required is necessary before choosing a co-creation approach. User engagement can be resource heavy in regards to time, skills, and funding. The time required for actively

engaging knowledge users and stakeholders may require extra meetings and coordination, development of materials that are accessible to multiple audiences, working through differences, and potential refinement or redirection of the project. It is critical to build in the time and care required to foster meaningful engagement so that older adults have a positive and enriching experience. The AGE-WELL transdisciplinary scoping review found the following factors useful for facilitating transdisciplinary working: institutional support [37, 38, 46]; a diverse, heterogeneous team [34, 35, 38]; using in-person and digital communication (including both a social and working component to engagement) [35, 40, 43]; and having strong team leadership with brokering skills [35, 38, 40, 47]. These facilitators are essential to all co-creation approaches.

From our experiences, critical to co-creation is having team members with the experience, interest, and relationship building skills to engage knowledge users and stakeholders in the process. While content and disciplinary knowledge are essential to research and innovation, co-creation approaches require skills for facilitating collaborative working. As Muller and Druid [48] state in regards to using participatory design methods in computer specification and design, “You can’t just add users and stir” (p. 3). It is important to recognize that projects will require space for the researcher or developer as well as older adults and other stakeholders to work through their differences of experience and knowledge, creating opportunities for learning and development for all involved. Essential here is to remember the human component: co-creation requires the messiness of getting to know people - sharing meals, laughter, frustrations, and creating new shared experiences together.

To support the creation of this space, capacity building within the team or hiring someone with engagement experience (e.g., a knowledge broker) should be integrated into co-creation projects. A sufficiently skilled team can support active engagement and ensure that work is conducted in an ethical manner, which is important given the unique challenges that emerge when using co-creation approaches. Ethical considerations of co-creation projects include the knowledge user requesting the product under development that may not be available beyond the life the project [49], non-disclosure and confidentiality agreements, intellectual property, and the return on investment of time and resources of the knowledge user [see 50, 51]. Thus, co-creation needs to address what it will be like for the older adult to be involved, including what they will get in return for their investment in the project and what will happen for them at the end of the project.

4 Conclusion

Many researchers are using co-creation methods to varying degrees. The co-creation experiences described here (community-based participatory research, integrated knowledge translation, transdisciplinary working) were dynamic, enriching, and appear to have real world impact. While each project had their own challenges, pitfalls, and resource demands, we found the approaches to be essential to the integrity and applicability of the process and outputs produced. We expect the success of technology solutions for older adults to increase if all stakeholders are thoroughly engaged in the research and development process because the solutions will be more accessible and

useable to the target population. However, comprehensively evaluating the impact of co-creation approaches on the research and implementation process and outcomes is challenging. Co-creation based research projects that demonstrate impact with a cost-benefit analysis are needed. Determining outcome indicators of co-creation projects that are measurable and contextually relevant will be challenging.

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