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Transdisciplinary training: what does it take to address today's "wicked problems"?

Euson Yeung*, Leslie Carlin, Samantha Sandassie and Susan Jaglal

Abstract

There is a growing need to address today's "wicked problems" seen in issues such as social justice, global climate crisis and endemic health concerns. Wicked problems are those for which there is no single, clear or optimal solution and thus are amenable to transdisciplinary solutions. Working in a transdisciplinary paradigm is thus seen as an increasingly necessary learned skill, and yet there is a dearth of knowledge on how curriculum centred around transdisciplinarity is perceived by those impacted by such curricula. This study examines the attitudes and responses of Aging Gracefully across Environments using Technology to Support Wellness, Engagement and Long Life NCE Inc.'s (AGE-WELL) stakeholders to the concept and role of transdisciplinarity in a training program intended to equip trainees and research staff from a variety of fields to address the "wicked problem" of aging well in Canada. We conducted 15 in-depth interviews with current AGE-WELL members, trainees as well as researchers and mentors, on the subject of designing the best possible training program. Our data illustrate the complexity of curriculum design and implementation to train for transdisciplinarity. We consider ways in which a shift in culture or ethos in academia may be required to pursue a thoroughly transdisciplinary approach to problem-solving. Short of instituting such a radical culture change as transdisciplinarity, however, strategic and conscientious efforts to integrate multiple and diverse perspectives, to attend carefully to communication and to foreground relationship building may well achieve some of the same goals.

Keywords: Transdisciplinary, Education, Training, Competencies

Introduction

In the light of the growing complexity of today's challenges and potential solutions, there is a pressing need to re-examine traditional methods of teaching emerging researchers and other professionals how to address what Rittel and Webber (1973) have termed "wicked problems". Wicked problems are highly complex issues characterized by lack of shape or definition and for which there is no single, clear or optimal solution. The reality of wicked problems can be seen in issues of social justice (Watts, 2013), global climate crisis (FitzGibbon & Mensah, 2012)

and endemic health concerns (Burman, 2018; Raisio, 2009; Smith et al., 2013).

One suggestion for addressing wicked problems is to deploy a transdisciplinary approach, where "transdisciplinary" refers to collaboration that transcends traditional disciplinary and sectoral boundaries (Burman, 2018; Head, 2018; Lang et al., 2012). Transdisciplinarity differs from multidisciplinary collaborations which rely heavily on unidirectional knowledge contributions from one or more relevant fields, or interdisciplinary approaches that promote bidirectional interactions between disciplines (Boger et al., 2017). A transdisciplinary undertaking, in contrast, (1) seeks to integrate knowledge and perspectives from diverse backgrounds to come to a shared and more sophisticated understanding of the problem at hand; (2) attends to relationship building and

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communication in ways that transform, re-conceptualize and extend ideas, methods and theories; and (3) encourages co-creation to rework and implement novel and feasible solutions (Boger et al., 2017; Grigorovich et al., 2018). At its best, applying a transdisciplinary approach to the wicked problem of aging well and gracefully produces better technology to support older adults, both directly and indirectly.

The question arises, though, of how to train emerging professionals to adopt such a transdisciplinary approach from the vantage point of teachers positioned within existing disciplines. In their examination of early-stage researchers' socialization, Felt et al. (2013) found that study participants grappled with a complex network of epistemic, institutional, social and ideological perspectives when engaging in transdisciplinary research as they sought to master their own disciplines as well as to work with others in their respective areas of expertise or "epistemic living spaces" (Felt et al., 2013). Educating for transdisciplinary practice goes beyond accumulating diverse and multiple perspectives; it requires researchers to learn to "speak a common language" with team members and other stakeholders (Faupel-Badger et al., 2015, p. 6). Research training in traditional graduate programs does not necessarily attend to the knowledge and collaborative skills needed to prompt innovations; rather, innovations happen in spite of the traditional training. Embedding transdisciplinarity within standard curricula is a challenge (Bernstein, 2015). Doing so requires an explicit curriculum designed with learning outcomes and learning processes that orient learners towards this aim. At present, there is a dearth of literature available to guide the design of a training or education plan that promotes a career working in a transdisciplinary paradigm.

AgeTech and transdisciplinarity

Promoting healthy aging and best quality of life for older adults is a case of a wicked problem that could benefit from inter-professional collaboration (Sixsmith, 2013). Dementia serves as an example: developing appropriate technologies for people living with dementia needs input from occupational therapists, engineers and computer scientists—each with their own disciplinary language and practices—as well as from people with lived experience of the condition, their families and caregivers (Boger et al., 2017). In Canada, not only is population age increasing as a result both of the "baby boom" years and because of extended life expectancy, but the elder population is also changing, becoming increasingly diverse ethnically, culturally and socioeconomically (Kirkland et al., 2015). In consequence, diseases and disabilities associated with aging are becoming more prevalent, including various forms of dementia, musculoskeletal conditions,

cardiovascular dysfunctions, malignancies, mobility difficulties, and sensory and other neurological impairments. The social landscape creates a further challenge because greater numbers of aging individuals live alone and are isolated, or residing in long-term care facilities. In other words, this wicked problem evolves. It is a moving target.

AGE-WELL: aging gracefully

Formed in 2015, the AGE-WELL (Aging Gracefully across Environments using Technology to Support Wellness, Engagement and Long Life NCE Inc.) training program was created to equip its trainees to tackle the complex and ever-changing health and social problems faced by older adults. AGE-WELL is a Canadian federally funded Networked Centre of Excellence (NCE) dedicated to merging research, appropriate technologies and services, enterprise and policy work to promote good health and the best quality of life in Canada's older adults (<https://agewell-nce.ca>). In this effort AGE-WELL brings together a multidisciplinary array of academics, industry partners, health professionals, and older adults and caregivers from over 80 different (self-reported) fields.

AGE-WELL's training program aims to develop transdisciplinary knowledge, skills and practice required to address complex real-world challenges in the field of technology and aging ("AgeTech"). By exposing AGE-WELL trainees (mainly graduate students and post-doctoral fellows) to multi-disciplinary research environments as well as to relevant stakeholders in the community (i.e. older adults), industry and governmental and non-governmental policy agencies, trainees from a wide variety of disciplines (engineering, medicine, allied health fields, social science, social work, commerce, etc.) are equipped for an equally wide variety of careers (entrepreneurial, academic, policy, industrial). AGE-WELL's year-long training incorporates self-paced, self-directed and experiential learning opportunities that require learners to interact with peers, stakeholders and experts. Activities within this program are varied and take the form of courses and lectures, seminars, workshops, journal clubs, internships, and—for some—a week-long intensive project-based experiential workshop. Topics range, for example, from managing intellectual property, to writing policy briefs, to exploring issues of empathy through the literature. Due to the self-directed nature of the program (referring here to the first iteration, 2015–2020), trainees participate in different combinations of learning activities to attain an affidavit of completion (the "Innovators of Tomorrow" certificate).

In this study, we investigate the attitudes and responses of AGE-WELL's supervisors, partners and trainees to the

Table 1 Interviewees

ID	Discipline	Status/affiliation with AGE-WELL
1	Engineering	Trainee
2	Occupational therapy	Trainee (completed)
3	Physiology	Faculty
4	Healthcare administration	Industry
5	Engineering	Faculty
6	Geriatric medicine, technology	Faculty
7	Computer science, speech and language	Faculty
8	Education, medical technology	Faculty/industry
9	Engineering	Trainee (completed)
10	Research manager	Faculty/industry
11	Occupational therapy	Faculty
12	Engineering	Faculty
13	Medicine, social science	Faculty
14	Law, philosophy	Faculty
15	Psychology	Faculty

concept and role of transdisciplinarity within the AGE-WELL training program.

Methods

We (EY, LC) conducted in-depth interviews by telephone, Zoom, or face-to-face with 15 key informants (Table 1) who belong to AGE-WELL as academic supervisors, industry partners or trainees. Interviews were audio-recorded with consent and securely transcribed. The semi-structured question guide was informed by a literature search on teaching and learning about technology and aging.

Interview topics included participant background, general thoughts and ideas about AGE-WELL and more specifically concerning program elements and core competencies that existed at the start of the training program (primarily from 2015 and 2016). Interviews lasted between 24 and 75 min with a mean duration of 49 min.

Following individual interviews, we convened a panel of nine AGE-WELL members in a face-to-face meeting, as part of the AGE-WELL annual conference in October 2017. During this meeting, which was structured in a manner similar to a focus group, three of the authors (EY, LC and SJ) presented preliminary outcomes of the interviews and drew from participants their perspectives on what mattered most in terms of developing a curriculum for trainees. The panel included research supervisors, trainees, industry partners and an older adult living

Table 2 Panel participants

ID	Discipline	Status/affiliation with AGE-WELL
1	Law, philosophy	Faculty ^a
2	Ethics, educational psychology	Trainee
3	Geriatric rehabilitation, technology	Faculty
4	Healthcare administration	Industry ^a
5	Health services and policy	Trainee
6	Gerontology, educational technology	Faculty
7	Occupational therapy	Faculty ^a
8	Computer science, speech and language	Faculty ^a
9	Social science	Faculty ^a

^a Also a key informant interviewee

with early-stage dementia, who represented older adult members of AGE-WELL¹ (Table 2). The notes from this exercise informed the further, full analysis of the interview data.

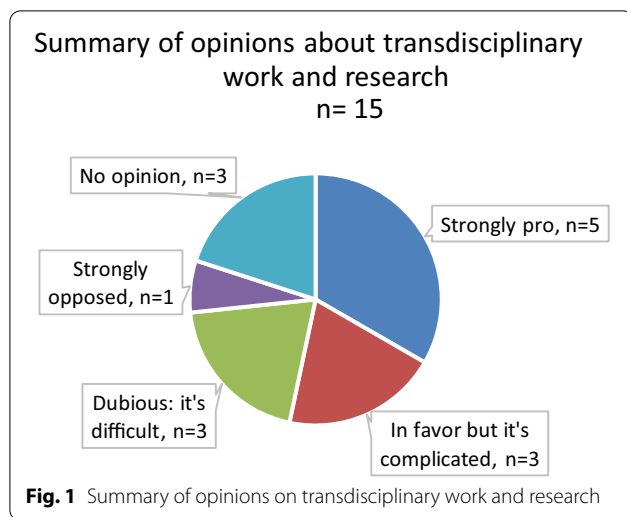
Two authors (EY, LC) analysed the interview data and the field notes, applying a qualitative-descriptive thematic approach to analysis (Sandelowski, 2000, 2010) to develop themes in the spirit of naturalistic, rather than theory-based, observation. The qualitative description designation is best used for data that do not spring from nor are tethered to a particular philosophical attitude about the research project. Lambert and Lambert (2012) refer to qualitative descriptive analysis as appropriate to “the least encumbered studies”, and this is the perspective from which we undertook our analyses. Our own roles as researchers (EY, LC, SJ) within AGE-WELL also placed us in the way of less structured, more casual interactions with research participants that informed our interpretation of the transcribed interview texts. We maintained reflective notes during the course of the project and referred to these sources during the analysis and writing-up of the material.

The interviews and the panel discussion covered a number of aspects of the training program; we focus here on those that illuminate participants’ attitudes and responses to the concept and role of transdisciplinarity within AGE-WELL in addressing the “wicked problem” of aging well in Canada.

Results

In-depth interviews investigated participants’ views on transdisciplinarity, its benefits and challenges within research practice and training contexts, and how their

¹ A number of the other participants fit the description “older adult”, but this particular individual belongs to AGE-WELL because of their experience of dementia and older adulthood.



views shaped their experiences with the teaching of and learning about transdisciplinarity.

Defining transdisciplinarity

AGE-WELL participants used the terms “transdisciplinary” or “transdisciplinarity” in varying ways, or not at all, sometimes using “interdisciplinary” and “interdisciplinarity” even when the interviewer persisted with “transdisciplinarity” (the term used in AGE-WELL’s documentation). Participants differed on characterizing the nature, importance, and practicability of transdisciplinary working.

“It’s not sitting around a table”, said P12 about what they referred to as “interdisciplinary” work, but rather being involved in each other’s domain: for instance, “a geographer and an engineer helping a nurse turn a patient”. For P13, on the other hand, a transdisciplinary perspective is more about engineers understanding social scientists sitting around a table, talking to one another. Transdisciplinarity is a “concept we’re trying to push quite strongly”, they said of AGE-WELL while acknowledging that “it’s a bit of struggle” to do so.

Benefits and challenges of transdisciplinarity

The AGE-WELL faculty and industry partners who participated in interviews saw AGE-WELL’s transdisciplinary approach to training and to practice as “unique”, important and challenging. In general, participants agreed on the need for working and training around transdisciplinarity. Seven of the 12 faculty key informants and one trainee fell into the categories of “strongly pro” or “in favor but it’s complicated”. Of those eight, only two expressed no doubts at all regarding the merit of transdisciplinarity (Fig. 1).

More specifically, participants articulated the importance of training learners to work collaboratively and to communicate with those outside of their own disciplines. The “ideal student in tech and aging” understands both transdisciplinarity and entrepreneurship, said P5, an engineer, and AGE-WELL’s focus on learning to “do the KT” (knowledge translation) offers a “unique” opportunity to become comfortable working across disciplines. An industry partner, P10, described transdisciplinarity as allowing for a deeper understanding and analysis of problems from perspectives different to those of “us” who are “within the forest”.

The goal of promoting such collaborative efforts is of course developing and promulgating innovations for aging well and doing that well. The benefit of promoting a transdisciplinary approach for AGE-WELL, said P11, lay in getting academics to think about commercialization, and in getting those in industry to think more about ethics and less about profit. A clinical faculty supervisor, P6, described transdisciplinary research as being more “lateral” and “real”: for AGE-WELL, asking how “real aging people” will make use of a product. “How do you keep adapting what you do, so that you fulfil as many of these needs on a regular basis as possible...?” P6 asked, suggesting that “AGE-WELL is breaking some of these molds” and working towards a different model of blending research and entrepreneurship.

The three participants who expressed doubts about the effectiveness of transdisciplinarity still regarded it as important, and even critical, but pointed out the difficulties of bringing it to bear on wicked (or any) problems. While AGE-WELL’s training program emphasized to students the importance of transdisciplinary working, P11 queried whether the research projects (that constitute the AGE-WELL program) succeeded in the endeavor. “You’ve got to keep pushing people out of their comfort zones to really make transdisciplinarity work”, they commented. P14, an academic, described “the immense pressure to stay in one’s [own] silo”, calling transdisciplinarity “a tough nut to crack” and continued, “There’s something about the way academics or scientists are trained that there’s always this gravitational pull away from interdisciplinarity as if it’s somehow cheating or diluting or bastardizing”. P15, a faculty supervisor, agreed, saying that transdisciplinary working requires a change in “culture” or “ethos”. The most negative view of all came from an academic who called transdisciplinarity a “terrible label” and “jargon”.

Teaching transdisciplinarity

P6 described both difficulties and rewards of teaching transdisciplinarity: “But I think that we haven’t figured out how to teach these kinds of competencies, this

transdisciplinary way of doing things, the thinking about the different needs of different stakeholders". P13, a faculty supervisor, agreed: "We know more about the basics of commercialization, for example, [and] we can certainly provide good training on that. Training in transdisciplinary working? Not as easy". P15 discussed the difficulty of teaching transdisciplinarity "for a week" during one of the program's learning activities (an intensive five-day Summer Institute) because when the trainees return to their programs, the "structure" does not support what they learned; rather, the emphasis is on remaining within one's own discipline. "[T]ransdisciplinary working is not something that you get taught about, either at undergraduate level or even particularly at postgraduate level. Because for that to happen you would need a whole ethos change in the research culture that we're in".

Participants expressed ambivalence about the need for incorporating transdisciplinarity given all of the other demands of work and research. P4, for example, spoke of both the benefits of such training and its challenges. Regarding opportunities for a student to attend a webinar on a subject outside their own discipline, P4, an industry partner, said, "...it would be nice, but honestly I mean these folks [trainees], they're in here to get a degree and to get out and to become productive", highlighting the tensions around teaching and practicing a transdisciplinary approach. This participant later said of their own research with respect to transdisciplinarity, "My god, we live that", with striking emphasis, suggesting that training in transdisciplinarity is superfluous: it is already part of what goes on in P4's research laboratory.

Learning transdisciplinarity: trainees' perspectives

The three trainees interviewed as key informants (KIs) expressed positive views concerning the idea of transdisciplinarity while acknowledging its challenges. The idea, said P1, is to "motivate you to interact with all the stakeholders in your area as opposed to just brainstorming who they would be [and]... just to have you interact with people outside of your core area...". P2 spoke enthusiastically about the value of "working beyond yourself" and said, "I would say the transdisciplinary piece is really key and any way that can get built into different training opportunities, I think, is phenomenal. I learned the most from working with people that were outside my own siloed perspective...you would have people from rehab science working with people from engineering and computer science, so people were working, certainly, from different backgrounds. They really hit the nail on the head on that one when it came to that summer program [Summer Institute], where we were put into groups to develop a solution and we all came from those different backgrounds". Later, P2 described the various

"networking" opportunities offered through AGE-WELL to be key to enhancing a transdisciplinary approach.

The transdisciplinary requirements of the program could also impose a burden. Said P1, "You're starting to get lost". This trainee also queried the evidence of the "effectiveness" of the transdisciplinary approach: "... it just sounded like it was pretty grey, inconclusive as to the effectiveness of it versus other research practices", wondering about the ideal "ratio" of transdisciplinarity to "traditional" PhD work for maximizing "success". P9, an engineer who had completed the AGE-WELL training program, felt puzzled as to how to go about implementing "transdisciplinarity and getting people from different backgrounds with different types of knowledge together to work on a project...in an effective manner so it's not just a disjointed effort".

User engagement and knowledge co-production

A crucial aspect of the transdisciplinary approach promulgated by AGE-WELL brings older adults along with caregivers and family members into the research team, which can lead to a different working pace and priorities. P14 described active participation of users as essential for "interdisciplinarity". P15 believed that transdisciplinary working requires "embedding" stakeholder or user engagement in the process. P6 discussed both the importance of knowledge co-production and the increased complexity and cost, in terms of time and funding; it makes the project "more relevant" but also "more complicated". They commented that "hammering out the REB took months instead of weeks". A trainee, P1, described the difficulty but also the rewards of learning to engage with older adults: "I think the goal is really just to have you interact with people outside of your core area and welcome them to the design and maybe co-design as much as you could". Part of such "welcoming" involved accepting that "not everything you're going to do is going to be published".

Panel discussion

Bringing a preliminary summary of the interview data to a panel of nine participants (see Table 2) convened at the 2017 AGE-WELL conference and asking for feedback offered further insight. The panelists talked about the "confusion" and "difficulty" around operationalizing a transdisciplinary approach to technology and aging; they asked each other how to define the concept, and debated whether the definition would include both working across disciplines in an academic sense, and working across sectors, i.e. academic and non-academic. We noted that some participants argued that success depended on incentivizing a transdisciplinary mandate and on "individualized" and "problem-focused" training.

Several people commented on the difficulty of making these changes within the AGE-WELL context and more generally of operationalizing transdisciplinarity. They wondered about “how to get there” in terms of both teaching and practice. No firm conclusions or consensus was achieved, but the tenor of discussion remained cordial throughout. Participants nonetheless regarded transdisciplinary working as core to understanding how to solve “wicked problems”.

Discussion

AGE-WELL’s training program states that it aims to “[B]uild research capacity and expertise to achieve excellence in research; transcend disciplinary boundaries to think and problem-solve creatively; [and] explore experiential design, co-production, and the importance of user research” (<https://agewell-nce.ca/epic>). AGE-WELL makes clear the centrality of transdisciplinary working. The question, as one participant phrased it, is “how do we go about working on that?”

Transdisciplinarity, although embedded in the AGE-WELL program goals when the program launched has—at the time of data collection—garnered a mixed reception. It is a very radical shift in teaching and practice. Our participants agreed on the importance of communication across disciplines and amongst sectors (academia, industry, government, older adults), but did not agree on transdisciplinarity as the only or even the best way to get there. They commented on the difficulty of getting from here to there (“how do we do this?”) and advocated for other ways to integrate multiple and diverse perspectives, to attend carefully to communication, and to foreground relationship building.

Three main points emerged. One is that training for transdisciplinary is difficult to accomplish, because the “pull” of traditional disciplinary roots and boundaries is strong. Participants largely agreed that a transdisciplinary approach to innovation within the field of AgeTech is a “positive good” in an ideal world; however, the actual world fails to provide support and reward for professionals who stray outside their own disciplines, or who stay outside them for too long. The pull back towards “the silo” or the academic home is a strong one. “Silos” loomed large for our participants and cast shade over the goal of transdisciplinarity. A similar issue arose some decades ago with the emergence of training for computer-supported cooperative work or CSCW (McManus & Aiken, 2016); (Forsythe, 2001a) (Forsythe, 2001b). These researchers and others have commented on similar vulnerabilities and challenges of transdisciplinary practices including lack of clarity of problem definition, unbalanced problem ownership, conflicting methodological

standards, and outcomes or solutions that have limited legitimacy and case-specificity (Lang et al., 2012).

Secondly, transdisciplinary research and innovation is less efficient for achieving specific goals than staying within one’s own discipline, and students are typically taught to conduct their work with maximal efficiency and are rewarded for doing so. Recall P6 who praised the benefits of teaching and doing transdisciplinary work, but also commented that getting a research proposal approved by the university’s Research Ethics Board took “months instead of weeks” because of the array of parties represented in the project. Learning to de-emphasize speed (efficiency) may be necessary to incorporate transdisciplinarity.

Thirdly—finally, and on a more hopeful and positive note—the AGE-WELL Summer Institute received much commendation from trainees as well as from supervisors and agency partners. In this intensive, brief (5-day) residential program, a select group of trainees from multiple disciplinary backgrounds are invited to work with an older adult or caregiver stakeholder to identify a problem and to develop a plan to solve it: an innovation. It combines elements of a hackathon and masterclass with close mentorship and integrated stakeholder engagement. It is in this small, focused and very personal environment that lessons about transdisciplinary working seemed most effectively imparted and implemented. This finding suggests that a “grassroots” approach to introducing transdisciplinary ethos is more likely to succeed than by imposing transdisciplinary from the top down, i.e. at the institutional level.

Limitations

We did not formally interview older adults who participate in AGE-WELL in their capacity as older adults, although a number of the faculty and industry partners with whom we spoke were indeed “older adults”—which raises interesting questions in and of itself. The topic of identity and membership within a particular group (or silo) merits further investigation and might shed light on the ways in which transdisciplinarity works towards training for complexity. Older adults were represented within the panel discussion. Other limitations include an imbalance in our participant sample between faculty and trainees; we interviewed fewer trainees than faculty, and all of the trainee-participants came from the first cohort of enrollees in the program in 2015.

Conclusion and future directions

Our findings add to both the hope and the doubt adhering to transdisciplinarity as a tool for solving wicked problems. The academy today erects walls more than it builds bridges between disciplinary islands; it is a system

unlikely to serve tomorrow well. Puri describes the current era as one in which education is ripe for disruption in the arena of digital innovation (Puri, 2018). Turning “digital innovation” into “digital transformation” is another “wicked problem”; Puri (2018) queries how universities might cope with guiding learners to acquire and practice the skills they will need. “As educators, we want students to learn and become more self-aware about how their academic disciplines intersect with the enlarging digital world and new research,” he argues. The same question troubles AGE-WELL training and mentorship in that traditional didactic methods: what Puri calls “the classical classroom” (i.e. lecturer in front an audience) no longer suffices to train adequately, especially towards a domain as intricate and complex as transdisciplinarity. AGE-WELL’s training program does not aim to replace the traditional discipline-based, competency-guided education, but to augment it and to provide integrated learning opportunities to fit rising professionals to work in a transdisciplinary capacity in their multiple, diverse careers. In so doing, they can “sneak up on” the wicked problem of helping an increasingly large aging population to age well.

Future research will include evaluation of the training program and following the careers of AGE-WELL trainees who complete the program, using such methods as social network analysis (Dawson & Hubball, 2014; Foo et al., 2019) to observe the paths they trace within their own discipline and how those intersect with colleagues across disciplinary divides. Such efforts will afford ongoing monitoring of longer-term, public-facing impacts of former AGE-WELL trainees as they help to address the wicked problem of aging gracefully and well.

Abbreviations

AGE-WELL: Aging Gracefully across Environments using Technology to Support Wellness, Engagement and Long Life NCE Inc.; NCE: Networked Centre of Excellence; KT: Knowledge translation.

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