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Scaffolding collective agency curriculum within food-systems education programs

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Collective agency (CA) can be defined as the shared understanding, will, and ability of a heterogenous group to take action and work together toward a common goal. We are motivated by the premise that CA is central to meeting the challenges inherent to 21st century food systems. These challenges include maintaining sustainable agricultural production and meeting nutritional needs of a growing population while protecting the climate, wildlife, soil, air and water quality, and enhancing equity, inclusion and justice for those who work in or engage with these systems. Given the importance of CA in food systems, university programs focused on food systems must address it. To date, despite many calls for higher education to build skills in CA, implementation has been minimal. Single courses addressing CA exist in some program-level curricula, but we know of no previous efforts in food-systems degree programs to systematically cultivate CA across their curriculum through scaffolding, i.e., interconnection and integration of learning activities across courses, so as to enhance their complementarity and impact. We (a consortium of university faculty building food systems curricula, located at University of British Columbia, Montana State University, and University of Minnesota) developed our approach to teaching CA through an action-research process, conducted during 2019–2022. In this paper, we report on our process and outline an emergent conceptual model of a curriculum for CA that can be embedded within broader, program-level food systems curricula. We describe its elements and share our experiences in implementing these elements. We conclude by describing current efforts to further develop CA curricula in the context of food-systems degree programs.

KEYWORDS

holism, agri-food system transformation, politics, pluralism, wicked problems

Introduction

Grand challenges face food systems in the 21st century. Broadly, these are to increase the sustainability and resiliency of nutrient-dense food production, including to climate change (Willett et al., 2019; Pörtner et al., 2022), to improve agriculture's effects on soil, water, wildlife, and climate (Rockström et al., 2017), and to enhance equity, inclusion, and justice in food

systems (Loos et al., 2014; Bennett et al., 2019; Backhouse et al., 2022). Present rates of progress on these challenges are mixed at best (Steiner et al., 2020). All represent urgent and complex problems (Levin et al., 2012) defined as (i) multifaceted, with social, economic, political, and biophysical aspects; (ii) highly uncertain and unpredictable; and (iii) involving multiple stakeholder groups, with unequal power relations, that view the problem and potential solutions differently. Inherent conflicts of interests and intense contestation have arisen around many facets of these challenges (e.g., Timmermann et al., 2018; Béné et al., 2019; Batista et al., 2019; Klerkx and Rose, 2020; Baudron et al., 2021 on food sovereignty, food security, animal agriculture, digital technologies, and biodiversity conservation and farmlands, respectively).

It is clear that individuals and organizations working in food systems are increasingly required to address complex problems of many different sorts and at many different scales as a regular element of their professional work. By definition, complex problems must be addressed collectively, at least in democratic societies. Therefore, complex problems require building shared understanding, will and ability to take action, i.e., a *collective agency* to address such problems jointly, in concert, and over the long-term (Hainz et al., 2016). In our view, such collective agency (CA) is central to meeting the challenges of 21st century food systems, and therefore people working in food systems must have skills crucial for effective *CA*. Herein, we outline conceptual and practical elements of a scaffolded CA curriculum, providing a fundamental and integrating element of curricula of undergraduate food-systems degree programs.

Our premise—the necessity of CA in the face of complex problems—is now widely espoused. Moreover, CA is at the heart of a range of frameworks that have been articulated and applied to understand and support societal response to complex common problems, e.g., co-production of societal transitions (Geels, 2019; Wyborn et al., 2019), socio-ecological innovation (Klerkx and Rose 2020), sustainable transition theories (Schlaile et al., 2017), and responsible innovation and scaling (Wigboldus et al., 2020). These frameworks primarily address responses to complex problems that seek transformational change at relatively large scales, although complex problems also occur at more local scales (Cabrera et al., 2018). These considerations underscore our expectation that CA will become an increasingly pervasive aspect of work in food systems. Yet, CA stands as a vitally important but difficult and demanding practice, inherently laden with friction, tension, and struggle (van Mierlo and Beers, 2018). Importantly, CA should not be viewed as a panacea capable of achieving rapid progress on complex problems. Rather, CA must be applied, with patience and persistence, to very different activities at different stages in the dynamics of complex problems (Westley et al., 2013). Collective response to such problems can be analyzed into "preparation," "transition" and "consolidation" phases (Folke et al., 2021). In many cases, extensive preparation is crucial—i.e., activities needed to create conditions for substantial progress on such problems—and patience and persistence are of the essence.

For decades, there have been calls for higher education to build skills in CA as a fundamental aspect of curriculum (Ostrom, 1998; Boyte, 2008; Neff and Albertson, 2020). A number of dedicated courses have been developed around such skills and understandings, in a range of disciplines (e.g., Kahne and Westheimer, 2000; Strachan, 2006; Peterson, 2014), and in co-curricular (Johnson, 2019) and secondary education (Bruce, 2018). In published reports, these courses appeared to be generally successful, but they are limited to single-course interventions in curricula. The emergence and success of these courses is encouraging. However, given the range of skills and capacities relevant to CA, a single-course intervention in a curriculum is likely to be insufficient (Strachan, 2006). Rather, deeper and more extensive development seem necessary, via scaffolding, i.e., interconnection and integration of CA learning activities across courses, so as to enhance their complementarity and impact. However, higher education curricula centering CA at the degree or program level are currently under-developed.

Building on the conceptual and pedagogical foundations noted above, and on previous work on food-systems curriculum development by the authors and others (Jordan et al., 2014; Valley et al., 2018; Ebel et al., 2020), we present a working model for a curriculum on CA in food systems, developed by food-systems degree programs at the University of British Columbia, Montana State University, and the University of Minnesota. We also present foundational concepts for our model, and then describe implementation efforts, lessons learned, and prospects as we move forward. To be clear, our working model is intended as an intentional and explicit component in the overall curricular "ecosystem" of food-systems undergraduate degree programs. Importantly, we regard our working model as emerging and provisional. We have built it from our experience as food-systems educators, and from our professional experiences in *CA*. Our aim is to advance discourse and experimentation around CA curricula in food-systems. We also hope to provide a curriculum of potential value in other undergraduate degree programs that address fundamentals of societal responses to complex common problems—e.g., environmental science, public health, engineering, and education.

Conceptual foundations of our CA curriculum

Public work and public workers

Certainly, CA is a broad concept; to focus and orient our CA curriculum, we identify an overarching goal: to empower and enable students interested in "public work." Following Boyte (2011), we define public work as a form of CA of broad importance: *sustained concerted action carried out by a collaborative group, in which the group creates, shares, and sustains public goods, defined as things of value to the group and some larger public within which the group is embedded*. This notion of public work is not a recent construct. Derived from philosophical pragmatism (Brendel, 2009), the concept of public work—and the related notion of "public workers" that achieve CA by doing public work together—provides an elegant, deeply-theorized (e.g., Brendel, 2009; Boyte, 2011), and practical basis for our CA curriculum. Conceptually, we outline the practice of public work as follows.

Public work on complex public problems (Figure 1) is a cyclic process, which begins with initial problem formulation, i.e., the recognition of a complex common problem by a group of involved persons, with a shared sense that "something should be done." In the context of food systems, the problem may involve any situation or aspect of a food system that is perceived as a persistent problem without evident solution. The initiating group begins collaboration in

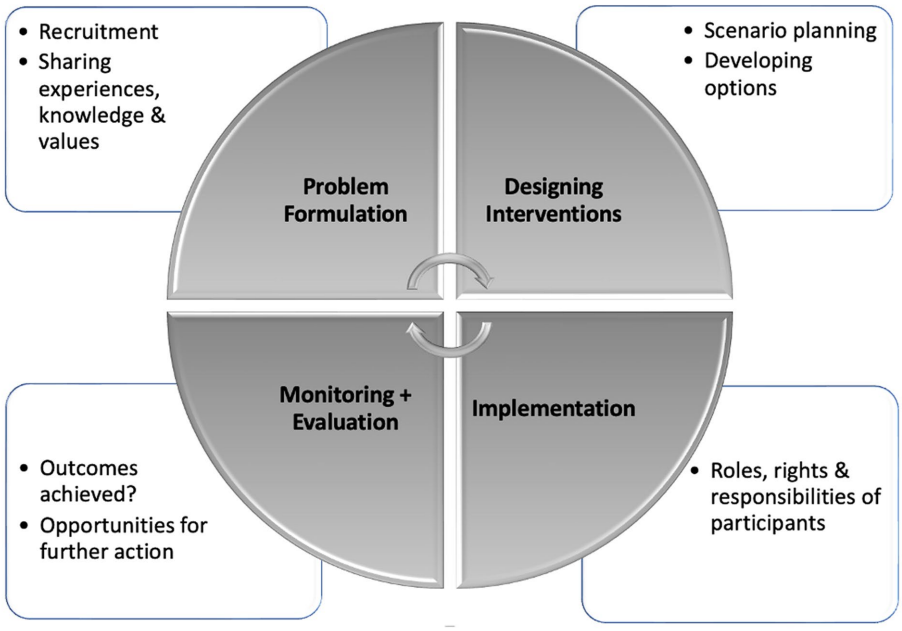

FIGURE 1
Idealized conceptual model of public work on complex public problems as a cyclic process. The process begins with initial problem formulation, i.e., dialogue to build a shared understanding of a complex common problem by a group of involved persons. The group can then shift to deliberative consideration of "What should we do?" to intervene in the problem situation. Implementation of interventions follows and outcomes are monitored and evaluated. Due to the shifting and multi-faceted nature of complex problems, it may then be necessary to revise the formulation of the problem itself, before designing further interventions.

earnest by sharing understandings of the problem situation, with a shared expectation that the situation and its problematic aspects are likely to be understood differently among the group members. The group may then enter a stage of broadening and **recruitment**, in which it works to recruit other involved parties, which may require broadening the scope of the problem situation to include aspects that are salient to other stakeholders, creating a "shared entry point" (Sayer et al., 2013) for joining public work. Often, this phase of public work will be slow and prolonged (Westley et al., 2013); by definition, complex problem situations have no solutions that are readily implementable when first engaged by a public work group. During this phase, emphasis is placed on building **broad-based understanding** of the problem situation, by exchange and appreciation of group member's various experience, knowledge, and values.

Gradually, effort shifts to a phase of **designing interventions** in the problem situation, i.e., purposeful efforts to make improvements in the problem situation. This phase may draw on disciplines such as design and scenario planning to collect and integrate experience, knowledge, and values; identify and, if possible, reduce critical knowledge gaps; and develop options for action. Finally, opportunities for **implementation** of resulting interventions are actively sought and taken, after definition of roles, rights and responsibilities of participants in implementation (Sayer et al., 2013). When action occurs, outcomes are monitored, key knowledge gaps are again identified and closed, and design and anticipation efforts again come into play in deliberation and negotiation of further action (Figure 1). Examples of similar approaches to transdisciplinary projects addressing a range of ecological sustainability problems are reviewed in Opdam et al. (2015) and Sayer et al. (2013). Importantly, this conception of public work does not presume that such interventions will solve the problem(s) addressed in a public-work effort. Indeed, these efforts may purely be "preparatory" efforts, preparing ground for the emergence and adoption of problem solutions (Folke et al., 2021). More broadly, it is important to appreciate that public work requires certain conditions (Geels 2020), namely stability of intentions and interactions over time; structural and functional conditions for effective cooperation (e.g., Ostrom's core design principles, Wilson et al., 2013), and reflexive capacities that help stabilize structure, function, and identity over time. Meeting these conditions requires resources, basic political stability and non-repression, and other factors. Therefore, public work should not be viewed as a universally available form of *CA*.

Corresponding to this notion of public work, and central to the notion of CA—we articulate an identity and associated practices of a **"public worker"** (following the articulation of Boyte and Throntveit, 2021). First, the public worker identity is viewed as ongoing and abiding, as opposed to something adopted temporarily in order to accomplish a particular action. Complex public problems are understood as refractory—perennial if not eternal—and therefore the need for public work does not end. Importantly, public workers are not altruists, investing effort purely to benefit others. Rather, the public worker seeks to build commonwealth, and is therefore both self-interested and interested in the well-being of others. Public workers take on work that is arduous; it is ongoing, slow, intensely relational, and intellectually, practically, and emotionally demanding. Through our curriculum development project, reported below, we offer food-systems opportunities to "try on" that identity and try their hand at the associated practices.

Our curriculum-development project

The authors are involved in food-system curricula at three universities (University of British Columbia, Montana State University, University of Minnesota), as instructors, instructional coaches, and curriculum designers, and comprise an ongoing collaborative network on food-systems curriculum development (Jordan et al., 2014; Valley et al., 2018; Ebel et al., 2020). We used educational design research and participatory action research approaches to develop a set of CA learning activities, implement and evaluate these as interventions in our current curricula, integrate these activities into a working curriculum model, and determine the outlook for further development of our CA curriculum.

The project group includes individuals (Clegg, Donovan, Sames, Stein, Valley) with primary training and experience in education. Advanced training, degrees, and professional experience include educational research and evaluation, academic advising, interdisciplinary and intercultural education, systems thinking, community and political organizing, educational administration, educational psychology and mental health skills coaching, and curriculum analysis and development. The other group members (Grossman, Hunt, Jordan, Michaels, Rogers, Peterson) have primary training and experience in a variety of scientific disciplines relevant to food systems. Advanced training, degrees, and professional experience include community-based participatory research, environmental science, economics, horticultural science, quantitative literacy, community-engaged learning, agronomy, and agroecology, and in pedagogy and curriculum design relevant to teaching these disciplines. The project group as a whole averages 18 years of teaching experience in higher education.

Collaborating institutions

To indicate the institutional context of our project, we briefly describe our degree programs and institutions.

University of British Columbia (UBC)

Within a major Canadian research-focused university, the Faculty of Land and Food Systems at UBC houses a number of degree programs that draw on a core set of courses throughout the undergraduate program years, which comprise the curriculum that we address in this report. These courses have a designator of "Land, Food, and Community," indicating their holistic scope. Each applies a critical systems framework, for the purpose of sequentially developing students' skills in community engagement, interdisciplinary collaboration, and power analysis at regional, national, and global scales. This core curriculum functions within a wide range of programs: applied biology; food, nutrition, and health; dietetics; food science; global resource systems; and food and resource economics. Instruction of the curriculum relies on a collaborative pedagogical model involving faculty, community-based instructors, and graduate student teaching assistants. As of the 2022/2023 academic year, there are approximately 1800 undergraduate students enrolled in programs that draw upon the core curriculum. The ratio of women to men is approximately 3:1, a notable feature of this student population is substantial representation by international students. The ratio of domestic to international students is just under 3:1, with international representation from 61 countries. Students from China and the U.S.A. make up more than half of international undergraduates. The mean age of students is 21.

Montana State University (MSU)

Our MSU program, Sustainable Food and Bioenergy Systems (SFBS), is situated in a US land-grant university; these institutions have a strong tradition of public engagement around research and education missions. The Sustainable Food and Bioenergy Systems Program at Montana State University is an interdisciplinary program offered through the collaboration of three departments across two colleges, College of Agriculture and College of Education, Health and Human Development. The Program curriculum fosters student growth as systems thinkers capable of addressing complex problems and offers ample opportunity for expansion of practical skills through a campus farm practicum and internships across the food system. Students within the SFBS Program are a representative sample of the overall student body at MSU; approximately 5% of enrolled students from marginalized or underrepresented backgrounds. The gender distribution is close to even, but women are slightly in the majority. About half of the enrolled students are Montana residents (49%), with substantial numbers of students from other states in the Western U.S.A. The average age of undergraduates at MSU is 21.

University of Minnesota (UMN)

Sustainable Agriculture and Food Systems (SAFS) undergraduate major at the University of Minnesota-Twin Cities offers students an interdisciplinary program of study emphasizing a systems approach to understanding and leading advances in food production, economics and sustainability. This program offers students an academically rigorous and relevant curriculum emphasizing deep knowledge of the contemporary food system, broad understanding of factors influencing the system, systemic approaches to problem solving, and local community engagement. A majority of students in the UMN degree program are from urban and suburban communities surrounding the Twin Cities area of Minneapolis-St. Paul, with an estimated 10% of enrolled students from marginalized or underrepresented backgrounds. The gender distribution is clos, but women are slightly in the majority. As for Montana State University, the gender distribution is close to even, but women are in the majority. Most students in the program are between 18–25 years old.

Methods

Participatory action research process

We used educational design research (Mckenney and Reeves, 2012) and participatory action research (PAR) approaches. PAR has proven effective for building understanding of complex educational innovation projects (Morales, 2016). We used PAR to elucidate and integrate the experiences, perceptions, and judgments of our project group in a collective project of curriculum development. In particular, we applied PAR to:

1) assess CA learning activities in the food-systems curricula at each participating institution at inception of our project;

2) design, implement, and evaluate additional CA learning activities;
3) integrate and apply these assessments and experiences into the ongoing development of our working CA curriculum model.

In essence, we used a PAR process that featured a cycle of collective assessment and evaluation of (1) how our food-systems curricula addressed CA; (2) subsequent planning and implementation of curriculum interventions to strengthen our curricula around CA; (3) and further assessment and evaluation. The participants in our process are all educators involved in our food-system curricula; we designed and conducted our process at this scale as our resources did not permit participation by other stakeholders (e.g., students, administrators) as co-researchers.

Our PAR research process (Figure 2), which included deliberations on our curricular intentions, identification and implementation of CA learning activities as interventions in current food-systems program courses, discussion of outcomes and learnings from these interventions, comprehensive assessment of the treatment of CA in our current food-systems program curricula, and design of a working CA curriculum, along a timeline extending from 2019—2022 (Figure 3). The project group (5 members from University of British Columbia, 3 from Montana State University, and 8 from University of Minnesota) met for an initial workshop in 2019, in which we discussed foundational ideas about collective agency and relevant learning activities. These discussions were assisted by an experienced practitioner (Donovan), who has taught courses relevant to CA on numerous occasions in several higher-education institutions. After these foundational discussions, we planned a set of focused CA learning activities that could be feasibly integrated into the existing courses of our degree programs. Supported by the coaching of Donovan, these activities were implemented in 2019 and 2020 (Figure 3) and in most instances were also implemented in subsequent offerings of these courses. We met periodically in virtual workshops to discuss outcomes from implementation of CA learning activities in our existing curricula. Concurrently, we used other virtual workshops to identify, document, discuss, and assess CA learning activities in our curricula, including the above interventions. This assessment revealed strengths and weaknesses of the implementation of the CA interventions, in addition to insight into scaffolding across courses. This assessment revealed that while our CA learning interventions had enriched our courses and curricula, our curricula provided only limited scaffolding or other integration of learning activities across courses and the undergraduate experience.

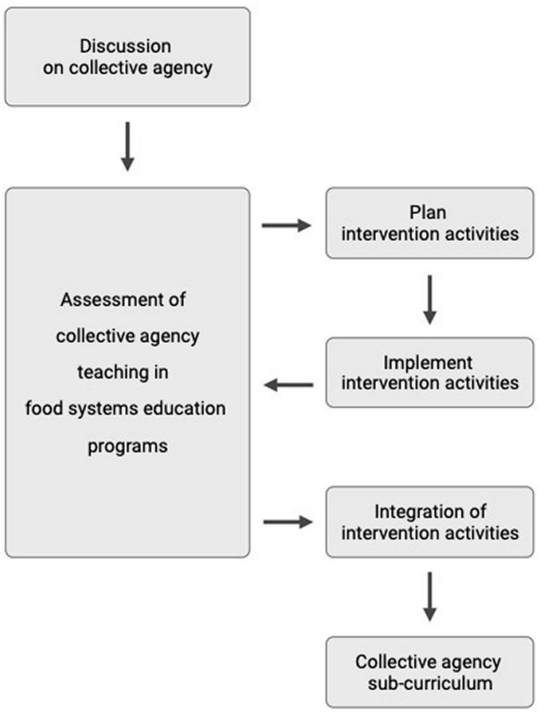

FIGURE 2
PAR process, which featured a cycle of collective assessment and evaluation regarding how our food-systems curricula addressed CA, subsequent planning and implementation of curriculum interventions to strengthen our curricula around CA, and further assessment and evaluation.

Motivated by this, we shifted to considering how CA learning activities, including our interventions and others, could be integrated and scaffolded across courses into a CA curriculum in our degree programs. We did this in additional virtual workshops, which led to the emergence of an integrative CA curriculum model. Finally, we held two virtual workshops for integrative and reflective discussions of the project to date, in March 2022 and June 2022. In these discussions, we assessed our progress, the status of the CA curriculum in each food-systems program, and next steps in development of our CA curricula.

Our PAR approach informally evaluated intervention outcomes using our experiences with previous instruction and observations of student work. Our method applied Schön's notion of knowledge construction by "reflection in action" (Schön, 2017).

Results and discussion

Collective agency curriculum working model

Our curriculum model (Figure 4; Appendix 1) aims to equip students for CA by developing key capacities for public work. It articulates multiple learning activities and outcomes across a sequence of courses. It provides opportunities for food-systems students to "try on" the identity of "public worker," and to try their hand, in a supportive learning environment, at certain key practices of public workers. Ultimately, the curriculum aims to enable achievement of food-systems program learning objectives and graduate attributes goals related to CA, as articulated in our previous work (Valley et al., 2018, 2020; Ebel et al., 2020).

The elements of the CA curriculum are presented in a scaffolded manner (Bauer and Clancy, 2018). This sequence (Figure 4) provides students with opportunities to build foundational knowledge and skills (in phases of considering and beginning public work, Figure 4). These can then be further developed and applied, at first in a classroom community, and then beyond the university. In these latter phases (Figure 4), student work begins within the bounds of the classroom through analyzing case studies, guided and structured deliberations, encountering fictional scenarios (e.g., Problem-Based Learning), and practicing engaging with social actors with whom instructors have

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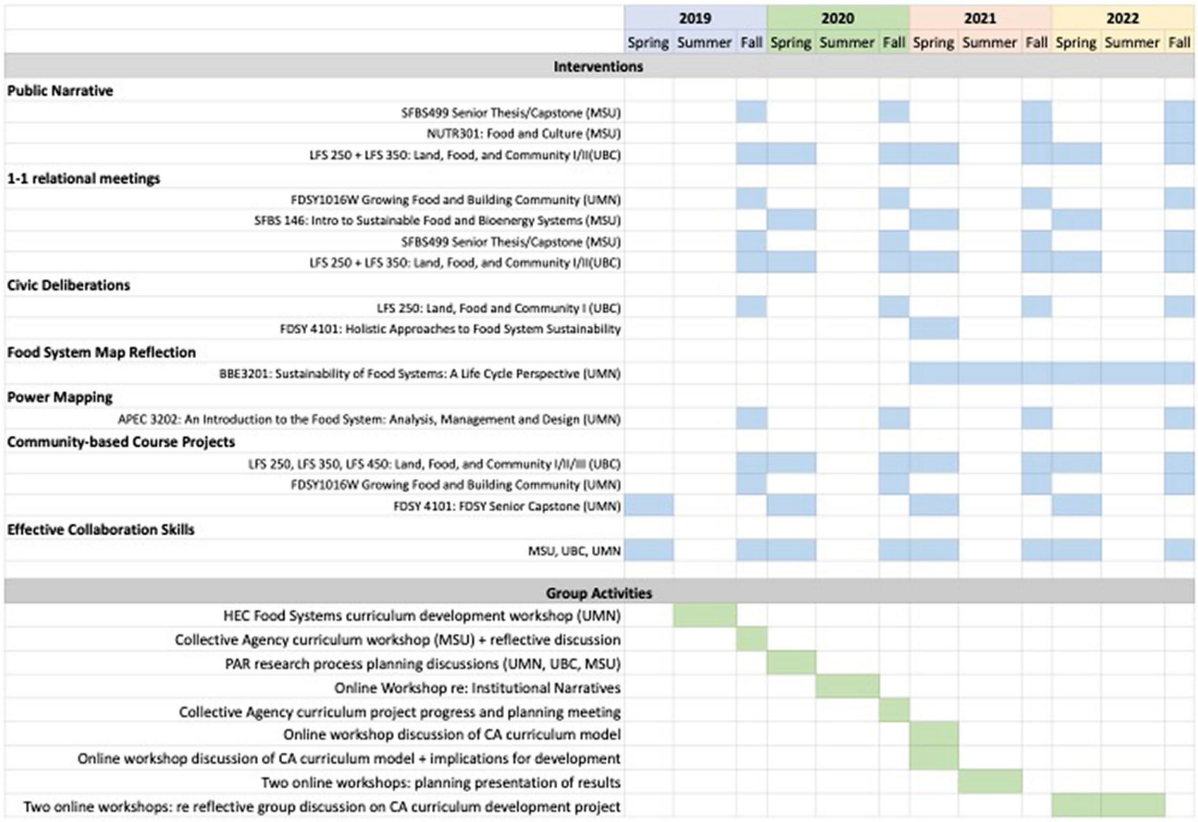

FIGURE 3
PAR research process timeline, indicating our action-research group activities, and CA curriculum interventions into courses of our food-systems degree programs.

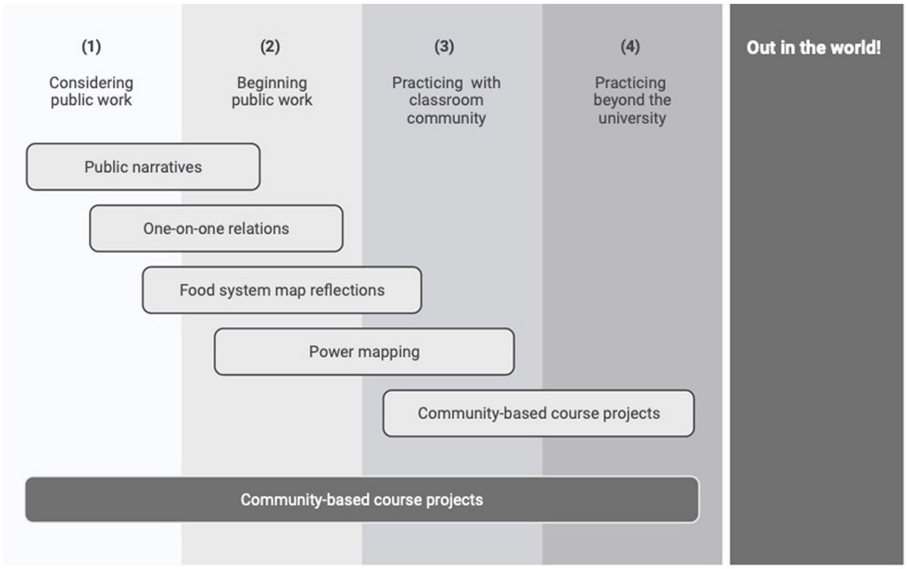

FIGURE 4
Collective agency curriculum model, illustrating the flow of learning activities across the undergraduate degree program. See Appendix 1 for additional details on learning activities and intended outcomes.

established relationships. Through support, feedback, and mentorship, the scope of student work expands into the public realm by way of community-based collaborations and advocacy in partnership with external social actors and organizations. This process creates an opportunity for students to wrestle with new concepts, practice new skills, and receive feedback prior to meeting community partners and

working on more complex issues. The framework is also iterative, through deliberate critical reflection and repetition of core processes associated with public work (e.g., public narrative, civic deliberations, and other activities), by which we hope to help students develop reflexive habits (Cunliffe, 2016) that emphasize building and maintaining working relationships across lines of difference. Finally, we include fundamental project management tools, which are key tools of public workers. Below, we describe the elements of the CA curriculum and our experiences with their implementation.

Toward a CA curriculum: pedagogical interventions in existing food-systems curricula

Prior to the full articulation of a working model for our CA curriculum, we developed and implemented a set of CA learning activities in our food-systems programs (Figure 2). Through these interventions we gained collective experience with most elements of our sub-curriculum. Most interventions are implemented on an on-going basis in our curricula (Figure 3). Below, we outline the pedagogical interventions that we executed during our project, presented in the order in which they appear in the working curriculum model (Figure 4).

Public narrative

Public Narrative (Ganz, 2011) is a powerful tool for public workers. It is used to help individuals develop their identity and self-awareness as public workers, and for groups (e.g., communities of place) to explore and develop a sense of shared fate, identity, and purpose in the face of complex public problems. It enables people in these situations to exchange views and perspectives in a way that builds mutual appreciation and understanding around their sense of the "world as it is" and the "world as it should be." Public narrative aims to translate values, concerns, and hopes into actions through the development and sharing of three stories: (1) a story of self (centered on personal life experience and critical choices); (2) a story of us (centered on awareness of being part of a community and group, and collective choice points) and, (3) a story of now (centered on current challenges and coming choices facing community and individuals) (Ganz, 2011). The use of stories, personal and collective, can transcend polarizing framing concepts and encourages people to empathize with each other (Slotterback et al., 2016).

At Montana State University, a public narrative activity is embedded within the senior level capstone course SFBS499: Senior Thesis/Capstone, taught by Stein. The public narrative activity is in alignment with the overall course objectives of strengthening student agency and enhancing oral communications skills. In this activity, students are asked to read about the public narrative approach and, through guided written reflection contemplate (a) key events, circumstances, or choice points that set them on the path they are on now (the story of self); (b) the values, experiences, or aspirations shared by a community they can identify with (the story of us); and (c) an urgent challenge, related to sustainable food systems, that they hope to inspire others to take action on (the story of now). Following this written reflection, students participate in a group dialogue through which they have the option to share their story of self.

In a post-course survey, students expressed that they found the public narrative exercise useful for deep contemplation of their own academic/career paths thus far and that it was a valuable activity through which they could better understand their peers. Following incorporation of the public narrative approach in this capstone course, activity materials have been shared with MSU colleagues within the food-systems degree program and beyond. The Capstone course instructor (Stein) has also incorporated the public narrative approach in the MSU course NUTR301: Food and Culture, within a Personal Food Narrative assignment. Stein also uses the approach regularly when mentoring students for public speaking engagements (2022 MSU Sustainability Summit) and oral presentations in general.

1–1 relational meetings

The purpose of one-to-one relational meetings is to understand what motivates another person to act, and to understand another individual's story of self, in the Public Narrative sense. In this activity, students practice listening with intention, strategically, and while withholding judgment (Chambers and Cowan, 2003), aiming to understand and appreciate the worldview and life experience of another, and to establish a relationship that could lead to collaboration in public work. These meetings are fundamental tools for public workers, because establishing such understanding and appreciation is crucial to creating collaborative relationships based on mutual appreciation and understanding. We define such relationships as mutual appreciation of shared goals and intentions around complex public problems, which provides an essential basis for taking constructive action together. In our interventions, 1–1 relational meetings are assigned in two first-year courses: FDSY 1016W: Growing Food and Building Community at the University of Minnesota (UMN, taught by Rogers) and SFBS 146: Intro to Sustainable Food and Bioenergy Systems (taught by Stein) at Montana State University (MSU), and the program Capstone course (SFBS 499, taught by Stein).

In the introductory courses at both universities, students are tasked with completing a one-to-one relational meeting with someone working in a food system. At UMN, preparation includes guidelines for fruitful meetings (Chambers and Cowan, 2003), and class discussion and role play. In initial implementations, the latter were guided by an experienced coach (Donovan). After the meetings, students write reflective essays addressing their emotions in the process, knowledge gained, lessons learned, and plans for making use of their learnings. At MSU, students reported that they gained better understanding of their partners' interests and had increased confidence resulting from developing relationships via these conversations. Yet, significant challenges were mentioned in reflective discussions, many students reported feeling discomfort or anxiety about meeting previously unknown persons. Also, students tended to seek out interviewees with whom they felt ideologically comfortable. We are refining this assignment to encourage students to connect with persons with whom they have some sense of difference.

Civic deliberations

Civic deliberations seek to build shared understanding of a public problem and to identify options for improving the situation, which are key requisites for broad collective action. Civic deliberations are particularly valuable for preparing students to enter the public realm and encounter passionate, heated discussions on food-systems issues

(Brush, 2020). Civic deliberations are a strategy to reveal and engage with differences in perspective on complex issues in society, where values-based stances are the norm. Deliberations give students the opportunity to practice speaking, listen deeply to gain insights into how perspectives and opinions vary on specific topics, and discuss approaches to address issues at hand. Unlike a debate, deliberations are not structured to determine right and wrong, but rather, to intentionally reveal tensions in order to motivate action and change. Civic deliberations are often considered a foundational process for civic engagement and public work (Dillard and Backhaus, 2007). We have gained experience with them in UBC's second-year course (LFS 250: Land, Food and Community I, taught by Valley and Clegg).

Deliberations are "hosted" by students working in groups, which are charged with choosing issues that lead to tension and motivate their colleagues to engage with interest and passion, in a small-class setting (*ca.* 30 students). The goal is to learn how to set the stage for discomfort, and to encourage those who speak often to step back and those who tend to remain quiet to step forward. Prior to starting civic deliberations, students create community agreements to calibrate expectations of language and behavior in order to be collectively responsible for inviting tension and passion into the classroom. Instructors do not participate in the deliberations, as their voices carry too much weight. However, instructors act as back-up moderators in case the intensity of the discussions reaches a level that needs support or intervention.

We believe that civic deliberation and its associated affective experiences are unfamiliar for most of our students, who are largely science-oriented. In initial deliberations, most students tend to stay quiet, and wait for an "expert" or "authority" to resolve tension and ambiguity. By the third deliberation, this tendency diminishes, as students recognize that the activity is not designed to reveal a single, correct, universal answer, but rather an opportunity to broaden awareness of interpretations, situate prior beliefs, develop new positions on an uncertain topic, and develop strategies for managing strong affective states, personally and collectively, in a respectful manner. We have also noted that in these food-systems program courses, it is difficult to find differing opinions on many important issues. Many students are ideologically aligned and the slight differences in perspective are minor.

Food system map reflection

Building appreciation of the wide range of actors in food systems—and their particular interests and circumstances—is a fundamental CA activity. A food-system map reflection activity has been integrated as an intervention in the UMN course BBE3201: Sustainability of Food Systems: A Life-Cycle Perspective (taught by Hunt), an asynchronous online course where undergraduates explore current topics in food sustainability through life-cycle and systems-thinking perspectives. The activity's purpose is to help students note changes in their perceptions of the food system over the duration of the class. At the beginning of the course, students are asked to review a food-system concept map (Nourish, 2014) and to identify interesting aspects. At the end of the course, students are asked to reflect on changes in their perceptions and thinking, as they view the map again. An important goal of this activity is to build understanding and empathy for other actors in food systems, setting the stage for building public relationships, engaging in civic deliberation, and collaboration in public work. In this way, the activity complements use of Public Narrative and 1–1 relational interviews. Students often report an improved ability to see specific topics (e.g., the economic "system") from multiple points of view, and an increased awareness of how different social and political interests can impact food systems at a range of scales. Moreover, many students acknowledge the potential power that individuals and collectives have to impact the food system in both positive and negative ways, a key insight for public workers, and one that is reinforced by another activity, Power Mapping.

Power mapping

As a tool of public workers, power mapping or power analysis (Noy, 2008) illuminates the agency of persons, groups, institutions, etc. involved in complex issues. In power mapping, actors within a particular situation or issue are characterized in terms of the kinds and amounts of power that they hold in relation to a particular issue. When used in classroom environments, students conduct power mapping in relation to an issue of interest (Mayo, 2020). Power Mapping has been introduced in the UMN course APEC 3202: An Introduction to the Food System: Analysis, Management and Design, taught by Peterson. Power mapping is incorporated as a milestone of a multi-week group project, with a final output of a policy brief that proposes action to address a food-system issue. In the weeks leading up to power mapping, groups complete a literature review on the issue and its context. Then, the concept of power and the practice of power mapping are introduced. In initial offerings, this has been done by Donovan, based on his extensive experience in working with undergraduates on power mapping. The project groups then draft a power map relevant to their project issue, and identify potential interviewees to further their understanding of the issue. They proceed to carry out an interview, and present findings in a report.

Power Mapping provided hands-on experience in appreciation of food-system issues from different stakeholder perspectives. In power mapping, students are instructed to think broadly about actors and forms of power relevant to their issue. In addition, they are expected to include stakeholder groups likely to oppose the response to the issue that the students advocate. Learning outcomes were particularly intense for groups that found their interviewees' viewpoints to differ markedly from their expectations. It is fascinating to read their reports documenting realization of the unexpected, followed by a pivot to listen to viewpoints of their interviewees. Peterson plans to rearrange future course offerings so that the entire class can benefit from these surprises, e.g., by presenting scenarios or simulations of unexpected turns in interviews and scheduling a class-time debrief where student groups report back.

Community-based course projects

In these projects, students collaborate with community partners to undertake some collective activity. These projects can be viewed as initial and piloting projects of public work. In the process, students engage their "head, hands, and heart" (Sipos et al., 2008) as public workers, experiencing complex problems, the people and organizations involved in them, and the outcomes of collective activities (e.g., as undertaken in the UBC courses described below). Such projects provide students with opportunities to witness and experience firsthand food-systems complexities and challenges facing their own communities, apply theoretical knowledge, and develop career-relevant skills by working directly with the public sector (Parr

and Trexler, 2011; Grossman et al., 2012; Jordan et al., 2014; Smith et al., 2014).

We have implemented CA learning activities in required core courses of our SFSE programs at both UBC and UMN. Programs require students to participate in scaffolded community-based projects, varying the intensity, complexity, length, and structured support offered as students matriculate through their programs. At UBC, these projects are part of courses LFS 250: LFS 350, and LFS 450: Land, Food and Community I/II/III, taught by Valley. In their second year, UBC students conduct highly structured 60—90 min food literacy workshops in a K-12 setting, and are required to do a pre-workshop consultation with teachers and a mapping of the school's food system. This first experience builds confidence in community settings prior to more immersive activities in program years three and four. In their third year, students spend 3 months in a community-based organization to implement activities such as proposal development, project implementation, or evaluation. Fourth year students then return their focus to their campus community, consulting with university staff on campus food system sustainability projects.

At UMN, a scaffolded two-course sequence taps into the urban center of the Minneapolis-St. Paul region, working alongside community organizations and public schools addressing issues of food justice, security, access, and distribution. First-year students in FDSY 1016 W are introduced to a variety of approaches to food system change through traditional field trips, where students learn about actions, outputs, and community impacts of partners. In their fourth-year capstone course (FDSY 4101, taught by Grossman), students are required in teams to design and implement a project that benefits a chosen partnering organization, providing 45 h of service to the organization. The capstone project culminates with a celebratory gathering in which students present the outcomes of their work to partners and the university community. Partners are selected through a competitive process based on submitted proposals, which include project ideas, location (to ease student transportation from campus), and expectations for outcomes and student learning. A majority of partner organizations have long-term relationships with faculty instructors in the UMN foods-systems degree program.

In both UBC and UMN programs, students report that these projects are novel and challenging experiences that provide gratifying and edifying experiences highly relevant to public work. These students—who are generally oriented to natural sciences—have often commented that these projects are their first experiences working outside of the usual parameters of the campus and classroom. Community partners generally express satisfaction regarding project implementation and outcome, while recognizing that they are working through the uncertainties and ambiguities of cross-sector collaboration. These projects certainly expose students to the complexity and fragmentation (among and within societal sectors) that make up the context of the food-system projects they are addressing. For example, students find that simply communicating with partner organizations can require persistent effort. Moreover, in post-project reflections, students have noted other hallmarks of public work on complex problems, including heterogeneous problem definition among stakeholders, difficulty defining scope of work and maintaining project boundaries, and structural limitations to systemic change.

Effective collaboration skills

Learning to work effectively over a sustained period—in public work or other collaborative settings—requires a suite of skills that is often under-developed in traditional degree programs. Such skills are at the heart of the day-to-day skill set of the public worker. These situations are very different from collaboration within hierarchical, command-and-control organizations, which is often mandated and defined by managers. In public work, most actors are choosing to collaborate voluntarily in complex, ambiguous situations, placing a particular premium on collaboration skills.

To sustain collaboration in public work, students must learn to stay in relationship with others through the ups and downs of sustained collective work. Development of effective collaboration skills is a critical learning outcome, pursued through activities that include project management and organizing skills. Successful project work requires organization strategies, such as developing team charters, setting meeting agendas, creating meeting minutes with action items, and establishing communication protocols. Both UMN and UBC courses addressing community-based projects utilize these tools as integrated features of graded assignments, which helps increase buy-in and provides opportunities for direct feedback to student groups on content and process. Team project charters, in which students outline concrete project deliverables, milestones to progress, and roles for each team member, have been a particularly important assignment. Lastly, these courses reinforce foundational skills introduced in other courses that are needed to organize public work in complex, ambiguous situations. In these courses, students read and discuss *Stoking the Fire of Democracy* (Smith, 2009) to engage with organizing strategies such as learning one's "why," developing relationships across difference, learning from mistakes, identifying power, and taking action. These activities reinforce and integrate related learning activities such as Public Narrative and 1–1 relational meetings, and thus serve as an integrating experience in the CA sub-curriculum. Also, UBC uses the Clifton Strengths Assessment.[1] This tool enables students to identify certain core traits and talents that manifest in group work, and prompts them to reflect on their dominant patterns and those of others.

Concluding reflections

We set out to develop a CA curriculum, viewing that curriculum as a crucial foundation for advancing food-systems degree programs, at our institutions and more generally. This intention led us to assess how CA was addressed in our own programs; to identify and implement a set of pedagogical interventions to advance CA in our programs; and ultimately to articulate a conceptual model to integrate these pedagogies into an integrated and scaffolded set—i.e., a CA curriculum. We implemented our interventions (Figure 5) to enable students to experience the process of Public Work as we conceptualize it (Figure 1). Our intention is to provide a set of scaffolded learning activities that build key capacities for CA by vividly engaging "head, heart, and hands."

1 https://www.gallup.com/cliftonstrengths/en/254033/strengthsfinder.aspx

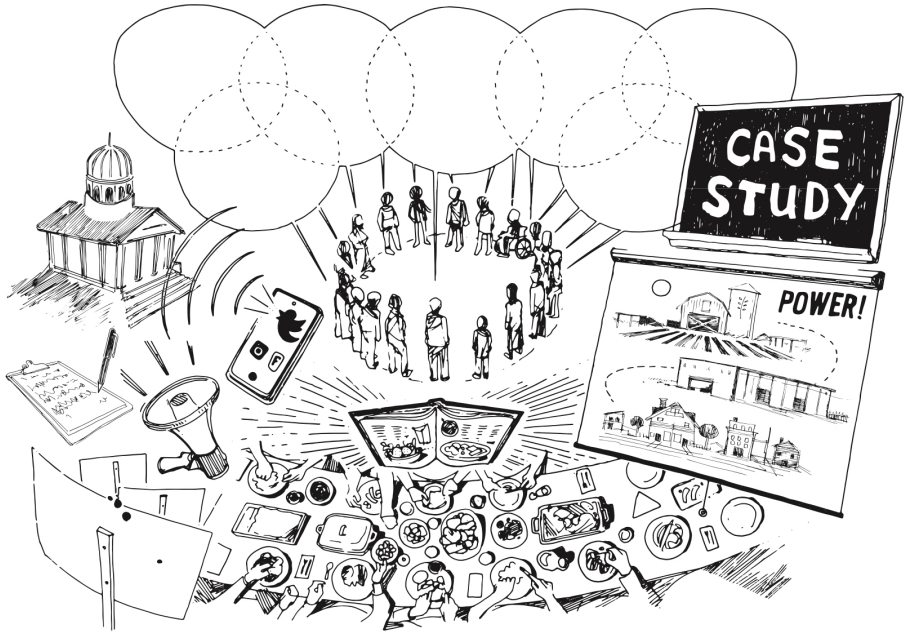

FIGURE 5
Public work cycle for food systems education programs, illustrating the sequence of learning activities offered to students in our CA curriculum. At the top of the figure, the overlapping speech circles represent the initial stage of public work, in which participants organize around a persistent issue to determine possibilities for collective action together. In this stage, students broaden recruitment, host civic deliberations, articulate public narratives, and conduct one-to-one relational meetings. On the right side of the figure, the process of designing interventions begins with considering case-study examples of projects and initiatives that have addressed similar issues locally, regionally, and beyond. Next, participants map the system in which their issue is embedded and identify the loci and forms of power. The bottom images in the figure represent the process of proposing, implementing and evaluating actions to address the issue. In the figure, we use the visual metaphor of communal eating, moving from recipe selection all the way to feasting together (and doing the dishes). The left side of the figure represents advocacy, disseminating new knowledge gained through the process of collective action and targeting specific locations of power to mobilize systemic change. At this point, the cycle starts again as new issues emerge from insights gained in the process as well as unforeseen impacts, which then require collective action to address different aspects and layers of complex, persistent issues.

Further implementation and development of the curriculum will require further implementation and refinement of its component learning activities across the three food-systems programs, to gain additional experience with these activities and to more deeply evaluate their outcomes. Also, it will be necessary to implement additional scaffolding of activities: i.e., further interconnection and integration of activities across courses, so as to enhance their complementarity and impact. Moreover, it is also necessary to enhance integration of the CA curriculum into our food-systems programs, so that students and faculty at each institution engage explicitly and consciously with the CA curriculum as a central element of the degree program as a whole. This scaffolding and integration are needed so that students and faculty more broadly and deeply experience the CA curriculum as a whole and can therefore provide feedback on their experience of the CA curriculum and on its effectiveness, inclusivity, and other key performance attributes.

In addition to such developmental efforts, there is also need for additional discourse, in all three institutions, re. the role of the CA curriculum in the future development of these food-systems programs. At each institution, the goal of enhancing CA, and active development of a CA curriculum, has been advanced by voluntary working groups that emerged from the larger pool of faculty stakeholders in these programs. Now that a prototype CA curriculum has been built, it is necessary to have additional dialogue among faculty and other stakeholders regarding the role of the CA curriculum in each program as a whole. Certainly, scaffolding and integration across curricula and degree programs are complicated by a number of factors. For example, students often take courses out of planned sequences, and many degree programs are offering increased flexibility in course selection. Also, course content can vary over time, particularly with changes in instructors, and there are often few means of governing course content. Such challenges must be addressed if there is to be additional scaffolding in the CA curriculum, and additional integration of the CA curriculum in these degree programs. These developments, if undertaken, will have costs and impacts on other learning activities in the degree programs, require professional development of faculty, and otherwise require resources and attention.

Despite these challenges of further implementation and development, we argue that development of CA curricula is vitally important work for degree programs in food systems (and in many other degree programs that must prepare students to address complex problems). Surely, current food-systems students will be faced with complex problems—and opportunities—in many different domains, and at a range of scales. In short, CA is increasingly necessary, yet it is generally under-taught, particularly in science-based programs. Moreover, CA skills are transferable, and popular with students. For these many reasons, we urge higher-education institutions to prepare students to engage in CA as a fundamental part of their future working lives.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the participants was not required to participate in this study in accordance with the national legislation and the institutional requirements.

Author contributions

NJ, WV, DD, DC, JG, NH, TM, HP, MR, AS, and MS contributed to project design, participated in analysis, interpretation of curricula, curriculum interventions, and reviewed and commented on drafts of the articles. DC, DD, JG, NH, HP, MR, MS, and WV devised and implemented curriculum interventions. DD, JG, NH, NJ, HP, MR, MS, and WV developed initial draft. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

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