



Mapping Inequity: The Campus Foodscape as Pedagogy and Practice

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Universities and colleges are fertile foodscapes for action-based education. They are physical and socio-cultural sites where pressing food systems problems play out at micro to macro scales. Structural inequities based on race, class, gender and gender identity, sexual orientation, dis/ability, and other forms of marginalization affect both access to food and to agri-food learning opportunities. In this article, we propose that students can learn through their everyday experiences of engaging with their physical and socio-cultural environment, namely the campus food system, by conducting foodscape mapping. Since 2015, the University of California Berkeley Food Institute has supported the Foodscape Mapping Project, in which students, staff, and faculty generate food systems knowledge while developing practical interventions to advance justice, equity, diversity, and inclusion (JEDI). We investigate how campus foodscape mapping might generate substantive learning about JEDI in food systems education; the kinds of learning that take place through foodscape mapping; and the educational practices and institutional structures that can support learning through foodscape mapping. We identify at least eight forms and processes of expansive learning that emerged through mapping work, using students' own insights into what they were learning. Finally, we reflect on our learning experiences in running the project, and develop broader design elements that other campuses can apply.

Keywords: foodscape mapping, campus food systems, food justice, social justice, pedagogy, learning, JEDI

I mean, this isn't even a hyperbole, but it was a life changer. Because I had never thought about food in this way, I could connect my personal interests in food with research in a more academic focused way with these different research tools.

~ Nathalie Muñoz, undergraduate transfer student

INTRODUCTION

Universities and colleges are not only institutions which provide sustainable food systems education that students then carry out into the world. Campuses are also fertile places for engaging in action-based education—that is, learning from experience in practicing social change—as they are physical and socio-cultural sites that reproduce larger food system problems. In particular, structural inequities based on race, class, gender and gender identity, sexual orientation, dis/ability, and other forms of marginalization affect access to both food and learning opportunities. Prior to (and further exacerbated by) the COVID 19 pandemic, 41% of students at universities in

the United States reported food insecurity (Nazmi et al., 2019). Yet hunger does not harm all students equally. Minoritized students are far more likely to suffer from food insecurity than other students—specifically Black, Latinx, Native American/Alaska Native, Native Hawaiian, LGBTQ+, foster youth, first-generation college students, student parents, financial aid recipients, and students who were food insecure as children (Martinez et al., 2018, 2020; Nazmi et al., 2019).

In parallel, food and agriculture-related majors and courses, often embedded in environmental science programs, frequently do not interrogate how their curriculum valorizes epistemologies and content that exclude non-dominant students' knowledges and experiences. By primarily focusing on agricultural production and nutrition through a Western scientific standpoint, these programs manifest what Ebel et al. (2020) call “problematic and harmful patterns of hegemony, ethnocentrism, ahistoricism, depoliticization, salvationism, uncomplicated solutions, and paternalism that permeate the food system and society broadly” (p. 7). Martin and Hartmann (2020) reveal how whiteness, racism, and homophobia intersect in agricultural education, creating hostile environments for minoritized students. When food systems equity issues are discussed, they are often treated as external to the university, rather than probed through the lived experiences of students. Moreover, the teaching practices and overall culture in environmental science departments are often hostile to Black, Indigenous, and other students of color (Esquivel et al., 2020; Cronin et al., 2021).

In recent years, researchers working in the food systems higher education space have called for a signature pedagogy for undergraduate curriculum (Valley et al., 2018; Ebel et al., 2020) that is equity-oriented (Valley et al., 2020), values-based (Galt et al., 2012), and student-centered (Galt et al., 2013). We add to this growing body of work by applying the theories of expansive learning (Engeström, 2001; Engeström and Sannino, 2010) and justice-oriented science pedagogy (Morales-Doyle, 2017; Davis and Schaeffer, 2019) to propose that students can learn through their everyday experiences of engaging with their physical and socio-cultural environment, namely the campus food system, by conducting foodscape mapping.

Engeström developed the theory of expansive learning as an extension of Vygotsky (1978) cultural-historical activity theory (CHAT) framework to account for the fact that learning is not simply a vertical process, by which individuals gain new skills and knowledge in their specific cultural environment through interaction with more advanced peers and teachers. While Vygotsky seminal work elucidated the fundamental sociohistorical aspect of learning, Engeström's intervention accounts for learning *in the unknown*: “People and organizations are all the time learning something that is not stable, not even defined or understood ahead of time. In important transformations of our personal lives and organizational practices, we must learn new forms of activity which are not yet there. They are literally learned as they are being created” (Engeström, 2001, p. 137–138). Engeström's theory thus focuses on the possibility of transformation through collective, horizontal learning where the current context is questioned, contradictions are taken as a given, and both articulation

of problems themselves and solutions are co-generated in cycles of inquiry. Engeström's theory of expansive learning emerged from his empirical work with Finnish families, medical personnel, and hospital managers learning together to address problems in health care for children with long-term illnesses. In dialogue with Engeström, Gutiérrez draws on her decades-long literacy work with high school students from migrant-farmworker families to bring attention to the possibilities of expansive learning in minoritized communities (Gutiérrez and Larson, 2007; Gutiérrez, 2008). She calls for learning ecologies that cultivate a “sociocritical literacy...that privileges and is contingent upon students' sociohistorical lives” (2008, p. 149). Likewise, Davis and Schaeffer (2019) state that justice-oriented science pedagogy emphasizes the learning power of students “examin[ing] socio-scientific issues of personal and communal importance” to them (p. 369).

Since 2015, the Berkeley Food Institute at the University of California, Berkeley (UC Berkeley) has supported the Foodscape Mapping Project as a pedagogy to catalyze participatory, justice-oriented food systems learning. The project uses the UC Berkeley campus as a living laboratory for students, staff, and faculty to generate food systems knowledge while simultaneously developing practical interventions to advance justice, equity, diversity, and inclusion (JEDI) in the campus foodscape. Foodscape mapping helps make the campus food system substantially more visible in a context where it normally exists as a largely invisible infrastructure. Campus members eat at dining halls, wander through a production garden, buy soda from vending machines, or take a food-related class, but rarely think about the larger structures and processes that adversely affect the lives of minoritized students and staff, configure the kinds of food and courses available, control whether gardens can be created, or determine the employment conditions of staff at campus eateries. With over 60,000 students, faculty, staff, postdocs and visiting scholars¹, over 45 eateries, a \$10 million PepsiCo pouring contract, a web of suppliers for dining halls, restaurants, and catering, and 185 food courses, UC Berkeley has a complex campus food system that contains many injustices and eludes ready comprehension.

Foodscape maps, then, can create the “missing object” of a campus food system. “By constituting missing objects—representations, tools, practices or artifacts that stand in for something that cannot be easily experienced or envisaged—people can speak about things that they previously could not” (Iles, 2005, p. 164). People can visualize the workings of the campus food system, bridge distances, catalyze dialogue, and interact with each other *via* missing objects that extend their cognitive and social capacity. Foodscape maps can also

¹In spring 2020 (reflecting pre-Covid numbers) the Berkeley campus consisted of: 30,411 undergraduate students; 11,667 graduate students, 1,511 regular faculty; 1,401 other faculty (i.e., lecturers and visiting faculty); 3,286 other academics (i.e., postdocs, staff researchers, librarians, and cooperative extension titles); 8,369 staff (operational, technical, professional, managerial, and executive); 4,160 affiliates/non-employees (includes visiting scholars and independent contractors); and countless community members and alumni who frequent campus regularly (Office of the Vice Chancellor of Finance, 2021) See: <https://calanswers.berkeley.edu> (accessed August 15, 2021).

expose the hierarchical and stratified decision-making power relations within a campus food system that lead to problems of equity and inclusion. More specifically, foodscape maps offer a “learning platform” (Röling and Jiggins, 1998) for students, faculty, and staff to come together to achieve both deep and wide learning about their campus by, for example, generating an array of spatial location maps, oral and written stories about minoritized student experiences with food injustices, visualizations of course offerings and “hot spot” tensions, and surveys of fraternity and sorority community food disparities. Maps can be developed according to the particular situations and needs of individual campuses. Mapping enables student learning in ways that are much more difficult in conventional courses and internships.

To better understand whether and how foodscape mapping can contribute to critical food pedagogy, in this two-part article we investigate the following research questions:

- How might campus foodscape mapping generate substantive learning about JEDI in food systems education?
- What kinds of learning takes place through foodscape mapping?
- What educational practices and institutional structures can support learning through foodscape mapping?

In part one, we provide an overview of the Foodscape Mapping Project before describing the pedagogical approach and structure of the learning environment underlying the mapping work. We then use an example of a Greek Life sub-project to illustrate the cycles of research and action that the project nurtured. To analyze the research questions, we draw on our participatory observations between 2015 and 2020 as the project leadership team (Fanshel as project director and Iles as principal investigator); reviews of student notes and feedback throughout the length of the project; and retrospective interviews conducted in mid-2021 with eight core student fellows. Based on this interpretative analysis, in part two we identify at least eight forms and processes of expansive learning (Engeström, 2001; Engeström and Sannino, 2010) that emerged through mapping work, using students’ own insights into what they were learning. Finally, we reflect on lessons from our experiences of running the project, and discuss several design elements that other campuses can adapt to meet their needs.

UC BERKELEY FOODSCAPE MAPPING PROJECT OVERVIEW

The UC Berkeley Foodscape Mapping Project is a democratically-produced, interactive digital map that offers extensive data on the structural factors affecting diversity, equity, and inclusion across campus activities and units. Our project’s working definition of a campus foodscape is: *Entities that make up food-related learning and practice, encompassing (but is not limited to) teaching, research, student organizations, activism, administrative decisions and initiatives, support services, campus gardens, dining services,*

*eateries, catering, and other procurement*². Developed through community workshops, student research, and visual and auditory design projects beginning in 2015, the map both reveals barriers to the full participation of historically marginalized campus members in food-related learning and practice, and highlights opportunities for, and successes in, overcoming such obstacles. To see what the map encompasses, visit the UC Berkeley Foodscape Map website (Berkeley Food Institute, 2021). Between 2015 and 2021, a core of 38 undergraduate and graduate fellows have engaged with the project through in-depth research and coursework, and 132 additional students have participated more peripherally in data collection and visualization. Over 2,500 other members of the UC Berkeley community have also contributed to the project *via* surveys, interviews, crowd-sourced data, and public events.

The project website includes two full-system maps that attempt to show the big picture of our campus foodscape: (1) the Campus Food Players, a power map which displays all foodscape nodes organized by formal reporting structure, allowing map users to see how decisions and funding travel through the system (see **Figure 1**), and (2) the Geographic Asset Map, which shows locations and useful data about important food-related services and facilities at UC Berkeley, from crucial basic needs services like the UC Berkeley Food Pantry, to campus gardens, eateries, and self-service facilities (lactation rooms, microwaves, water refill stations, and zero-waste stations) in and around campus buildings (see **Figure 2**)³. Eighteen additional “spotlight maps” explore structural inequities and/or celebrate successes in achieving change for JEDI in specific foodscape nodes within the four broad categories of academic units, campus facilities, service units, and student leadership. The maps are a patchwork quilt of different visual, narrative, and auditory designs that represent the creative choices of student mapmakers. A broad spectrum of social science and physical data collection methods inform the maps, including surveys, content analysis of archival documents, key informant interviews, oral histories, crowdsourcing, and physical surveys (see **Table 1** for details on each spotlight “map within a map,” data collection methods, and map type). The maps collectively shed light on how the campus food system operates in everyday practice and how it affects community members’ lives.

Beyond the map as a “product,” the Foodscape Mapping Project continues to be a learning platform that interweaves community-based participatory research, pedagogy, and advocacy. Through cycles of inquiry and action, the project has evolved across a series of iterations and sub-projects rather than as a single overarching effort: it has followed various “hot spot” topics circulating in the campus community and the interests of individual student team members. In 2018, the project team held a large public town hall and summarized the research findings to date into a synthesized report that offered policy and program recommendations and identified entities throughout UC Berkeley’s institutional structure with the influence to

²See Vonthron et al. (2020) for an extended discussion of what a “foodscape” entails.

³The Geographic Asset Map is also available in mobile application form, *via* Berkeley Mobile.

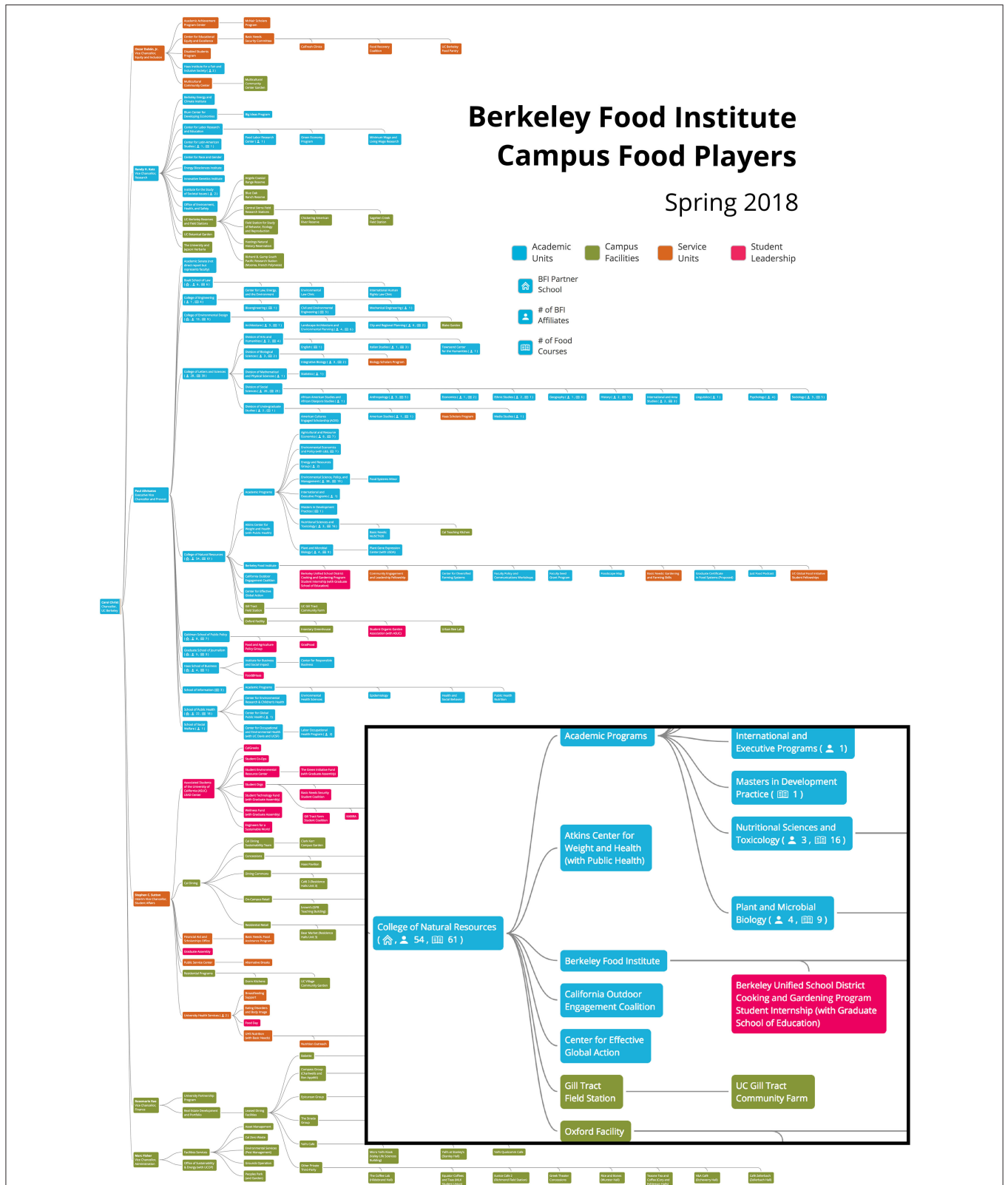
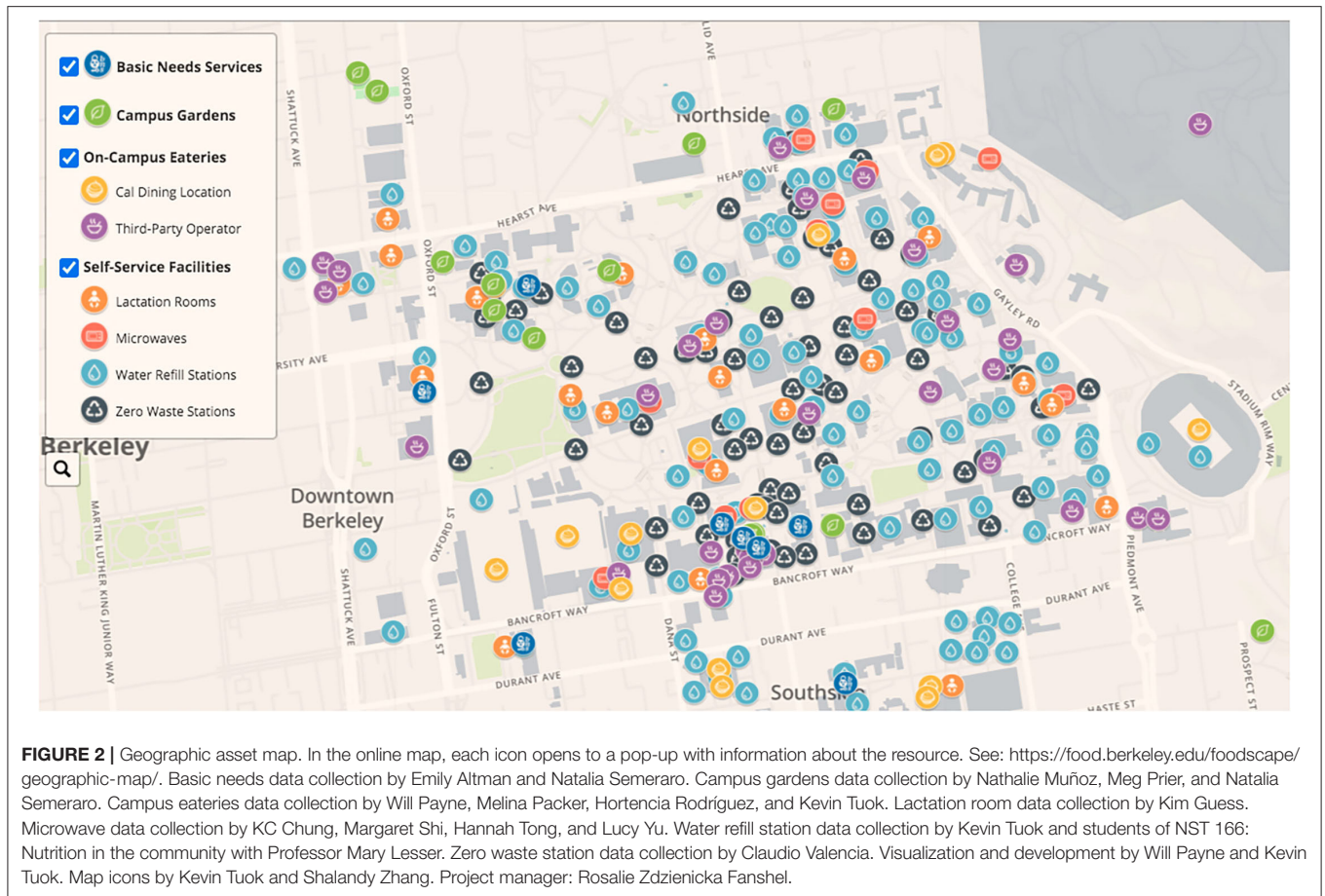


FIGURE 1 | Campus food players, with the animated power map fully expanded. The inset features a detail. In the online map, each tile contains a live link to the unit. See: <https://food.berkeley.edu/foodscape/map/>. Data collection by Angelina Amezcua, Nadia Barhoum, Rosalie Zdzienicka Fanshel, Melina Packer, Will Payne, Dennis Uyat, and Kara Young. Final visualization by Will Payne.



enact change (see Fanshel et al., 2018). The town hall and report enabled the project team—and campus community members—to have a comprehensive perspective of the UC Berkeley foodscape for the first time⁴. This sparked subsequent cycles of data collection, mapping, and advocacy projects to seek specific changes for JEDI in the UC Berkeley foodscape.

PEDAGOGICAL APPROACH

As a pedagogical approach, the Foodscape Mapping Project is broadly rooted in the critical principles of praxis, or knowledge generation and regeneration through action, reflection, and dialogue (Darder et al., 2017; Freire, 2018). We take seriously Freire’s (2018) call for a “problem-posing education” where learners develop consciousness of forms of social domination in their own contexts to work toward liberation, as opposed to simply “problem-based education.” The project recognizes students as authoritative producers of knowledge about campus food systems, and draws on their own lived experiences before and during their time at Berkeley to identify and inform

the specific topics to be researched as well as methods of inquiry (hooks, 1994; Gutiérrez, 2008). Our primary pedagogical inspirations for a food systems critical pedagogy derive from justice-centered K–12 science education and U.S.-based agri-food social justice movements.

In the context of formal schooling, scholars in K–12 environmental science education offer interventions in the white supremacist underpinnings of a dominant science curriculum that is veiled as “objective,” neutral, and acultural while failing to academically serve low income students and students of color (e.g., Bang and Medin, 2010; Morales-Doyle, 2017; Davis and Schaeffer, 2019). They advocate for a curriculum that recognizes the interconnections between scientific and social worlds and uplifts place-based, community-derived knowledge and lived experience. Morales-Doyle (2017) introduces justice-centered science pedagogy as a framework for addressing dominant scientific education’s historic role in (re)producing social inequities. Building on critical pedagogy and culturally relevant pedagogy (Ladson-Billings, 1995), justice-centered science pedagogy aims to develop “transformative intellectuals” (p. 1,037) who excel academically *and* develop critical consciousness through engagement in epistemologically heterogeneous, participatory learning activities that address scientific problems relevant to their communities. As a concrete example of justice-centered science pedagogy, Morales-Doyle

⁴We recognize that the view was by no means complete—the project had mapped 20 nodes out of over 50 we had identified. Yet synthesizing the Campus Food Players, Geographic Asset Maps, and various spotlight maps into a policy report did indeed reveal the hitherto invisible foodscape.

TABLE 1 | Foodscape mapping project full system maps and spotlight maps.

Map name	Data collection method	Map type
Full System Maps		
Campus food players	Web and archival searches, stakeholder meetings	Animated horizontal organizational chart
Geographic asset map	Physical surveys	Dynamic geographic map
Spotlight Maps		
Academic Units		
Accessibility at research spaces	Site surveys, legal analysis, interviews	Illustrated and animated graphic
Food and agriculture courses	Web scraping and content analysis	Animated timeline and stream graph
Hot Spot: Oxford Tract (<i>an agricultural field station that was slated for housing development; cross-listed with Campus Facilities</i>)	Environmental and social cost benefit analysis	Narrative with photos and tables
Campus Facilities		
Campus gardens	Biophysical and social surveys	Animated satellite view map
Campus garden stories	Oral history, interviews, critical reflection	Audio and video portraits; narrative report
Hot Spot: Oxford Tract (<i>an agricultural field station that was slated for housing development; cross-listed with Academic Units</i>)	Environmental and social cost benefit analysis	Narrative with photos and tables
Microwaves and water refill stations	Crowdsourcing (Microwaves) and physical survey (water refill stations)	Illustrated and animated graphic
Sustainable and just catering	Policy and best practices analysis	Resource list
UC field stations	Web directory searches	GIS, using Carto
Service Units		
Coalition for healthy campus food and beverages	Stakeholder meetings, physical survey	Narrative
Basic needs: food security	Deidentified pantry usage logs and program enrollment records; physical food weighing	Illustrated and animated graphic
From garden to pantry	Physical food weighing	Illustrated and animated graphic; bar graph and pie charts
University health services stories	Oral history	Audio portraits
Wellness program for high risk jobs	Deidentified health screening and program enrollment records	Narrative with photos, tables, and bar graphs
Student Leadership		
Greek life	Semi-structured questionnaire	Illustrated graphic and pie charts
Learning through our food	Oral History	Watercolor paintings and audio portraits
Student cooperatives	Semi-structured questionnaire	Illustrated graphic and pie charts
Student groups	Semi-structured questionnaire	Illustrated graphic and animated donut charts
Student group stories	Open-ended interview and oral history	Video and audio portraits

provides an extended case study of a year-long unit on soil in an Advanced Placement (AP) chemistry class at a community-founded high school in an economically-marginalized urban Mexican community in the U.S. Midwest. In contrast to the dominant AP science curriculum, the soil unit situated development of hard chemistry skills in the context of a deeper inquiry into environmental racism affecting the students' lives through centering diverse learning activities around the recent closure of two neighborhood coal power plants. One activity saw students testing soil samples for the presence of toxins such as lead and relating the results to their community's exposure to power plant emissions. Students then reported back to the community at a town hall, highlighting how their

education included public outreach. In another example, Davis and Schaeffer's (2019) ethnography of Black 4th-/5th-grader agency in a Michigan school with a justice-centered, place-based unit on water highlights how their pedagogy accounted for the "complex experiential, emotional, spiritual, and cultural associations of people and groups (e.g., Black Americans, Indigenous peoples)" have with water (p. 367). Importantly, justice-centered science pedagogy "encompasses curriculum, teaching practices, and classroom structures" (Morales-Doyle, 2017, p. 1,035): it is a holistic framework that guides us toward a new learning ontology.

Outside formal education, a long tradition of peer-to-peer, non-hierarchical knowledge-making exists in agri-food social

justice movements in the U.S. For example, *teatro campesino*, or field-based educational skits by and for farmworkers, emerged as a powerful sharing tool during the 1965 Delano Grape Strike (Bagby and Valdez, 1967) and continues to be used by predominantly Latinx farmworker organizations today, such as Líderes Campesinas in California and the Coalition of Immokalee Workers in Florida (Blackwell, 2007; Haedicke, 2020). Since the 1930's, the Highlander Research and Education Center (formerly the Highlander Folk School) has served as a hub for adult popular education, participatory research, and cultural work in low-income Black and white communities in Appalachia and the southern states. Most famous as a training ground for organizers in the labor union movement, Civil Rights Movement, and anti-strip mining activism, Highlander also worked with farming cooperatives in the 1940–50's and since the 2000's has organized a land and sustainability initiative (Thayer-Bacon, 2004; Highlander Research and Education Center, 2021). Peer-to-peer learning processes have also long been at the center of agroecological farmer networks [e.g., the *campesino-a-campesino* learning described in Holt-Giménez (2006)], as well as numerous other farmer field school programs worldwide.

Accordingly, the Foodscape Mapping Project has taken a strong community-based, participatory research orientation (Wallerstein et al., 2018) by purposefully engaging in processes aimed at co-learning, capacity building, and empowerment of participants (primarily students, but also university staff and faculty). The Foodscape Mapping Project grew out of an initial project on equity and inclusion in UC Berkeley's food system, which held community workshops to gather diverse perspectives. Participants noted they did not understand how the campus food system worked, or what power relations and decision-makers might affect the system. Subsequently, through brainstorming sessions with post-it notes and diagrams, the original project team (consisting of staff members and graduate and undergraduate student fellows) proposed that a mapping approach might provide this information—in effect, constituting a missing object. Mapping has emerged as a popular tool in food systems scholarship, particularly in studying local foodshed production capacity (Peters et al., 2009; Kremer and DeLiberty, 2011; Taylor and Lovell, 2012) and food access issues (Widener, 2018; De Master and Daniels, 2019). Elsewhere, we have detailed in an extended case study (Fanshel and Iles, 2020)⁵ the process by which the map took form, how students were recruited, what existing campus educational and research programs could be leveraged, and the funding that made it possible.

The project's emphasis on research stems from its conception by Rosalie, who is a staff member of the Berkeley Food Institute (BFI), a cross-campus center aimed at cultivating diverse, just, resilient, and healthy food systems⁶. BFI has a strong interdisciplinary research model that encourages collaboration

between faculty, staff, and students. Doing research not only generates information otherwise not accessible but generates credibility and authority within a university context, and matches the campus mission of making knowledge. While undergraduate, masters, and doctoral students have been fellows in the project since the beginning, they initially did not do research. Rather, their involvement during the 1st year centered on programmatic development and advocacy with the aim of making changes for JEDI.

Yet participatory research, activism, and pedagogy are profoundly intertwined (Hale, 2008; Freire, 2018). Rosalie and Alastair (who was BFI's faculty co-director at the time) realized that the Foodscape Mapping Project had the potential to also serve as a learning platform. Røling and Jiggins (1998) explain how the use of platforms comprising stakeholders to support mutual learning for problem-solving enables collaborative learning. Students, staff, and faculty—along with administrators—can use a campus foodscape map as a platform to come together to understand JEDI problems, and make decisions on what to do to remedy those harms⁷. In this way, the Foodscape Mapping Project attempts to create spaces for expansive learning (Engeström, 2001), that is “learning in which the learners are involved in constructing and implementing a radically new, wider and more complex object and concept for their activity” (Engeström and Sannino, 2010, p. 2).

As a result, we soon pivoted to a mapping model founded on modular research projects with an intentional pedagogical design. This was evident in how students approached framing research questions, choosing particular foodscape nodes to examine further, identifying specific research tools, and determining how to present data. To map inequities in the campus foodscape, students (with guidance from Rosalie and Alastair as project leads) asked research questions such as: How do inequities in food access mirror inequities in access in each of these foodscape nodes? Which students can participate in food and agricultural coursework and research opportunities? Who benefits from campus garden activities? How can a climate of inclusivity, equity, and diversity in food and agricultural research, teaching, service delivery, and activism be cultivated at UC Berkeley?

Other university-based food systems projects with similar goals include the University of British Columbia Food Systems Project (Rojas et al., 2007) and the Brown University Providence Foodshed Justice Mapping Project (De Master and Daniels, 2019). However, these projects focus on campus sustainability and the local city, respectively. The UC Berkeley Foodscape Mapping project instead centers *equity* within the campus foodscape, and takes an explicit advocacy stance by seeking to make change in that system. Through iterative cycles of studying

⁵The paper is openly available at: https://food.berkeley.edu/wp-content/uploads/2021/11/CSE_Fanshel_Iles_1120325.pdf.

⁶Other lead collaborating organizations at the project's inception included UC Berkeley research centers and student service programs: the Othering and Belonging Institute, Centers for Educational Equity and Excellence, and Multicultural Community Center.

⁷For example, Steins and Edwards (1999) note: “A crucial element in collective resource management by Australian Landcare groups is the strengthening of ‘land literacy.’ Land literacy refers to activities designed to help people appreciate the signs of health and ill-health in a landscape, to understand the conditions of and trends in the environment around them, and to make the invisible become visible (Campbell, 1994)” (p. 247–248). The creation of Landcare groups provides the learning platform.

the foodscape, participants are using the map artifact to become agents with the ability to create alternatives to the status quo.

Power is embedded in how maps are researched, represented, and communicated. It plays out in the underlying ideologies of cartographers, built-in assumptions of cartographic tools, technical approachability of maps for both makers and users, and performance of legitimacy of knowledge that maps generate and omit (Crampton and Krygier, 2006; Crampton, 2009; Kim, 2015; Monmonier, 2018). For example, racially and economically marginalized communities are often problematically represented through a deprivation gaze by the use of the term “food deserts” to describe food availability, when the communities may actually feature urban gardens, food sharing circuits, and corner stores that are largely invisible to usually white scientists who lack connections with the groups they purport to study (De Master and Daniels, 2019). Our project, therefore, asked participants to reflect during their research on how mapping the Berkeley campus foodscape might encode prevailing power inequalities and how they might do research to make maps that portray complex narratives. Reflecting this “multiple stories” ontology, the map comprises many maps at once, is both a cyclical process and provisional product, and uses multiple visual and auditory methodologies to tell the story of UC Berkeley’s foodscape from as many perspectives as possible. No single map can capture the full texture of this system.

RESEARCH METHODS

To investigate our research questions, we used a case study approach with mixed qualitative methods, combining participatory observation, notes and materials produced throughout the project, and retrospective interviews with core participants. Rosalie (project manager) and Alastair (principal investigator) both conducted participatory observations as the project developed between 2015 and 2021. This spanned a large range of activities associated with the mapping work, including: initial community workshops to articulate the project objectives; regular research team meetings; map visualization design discussions; presentation of map results at town halls; a semester-long case design course; advocacy meetings with campus leadership; and population-specific interventions related to map findings. We had access to comprehensive materials from all the various sub-projects, such as emails, detailed meeting notes, student fellow reports, collected data, each iteration of sub-project research designs and draft map products, and the publically-available map itself. Through a series of conversations as co-authors in preparing this case study for publication, we reflected on whether and how the mapping work had contributed to student learning about JEDI issues in the campus food system, the kinds of learning that took place in the project, and the educational practices and institutional structures that helped or hindered the mapping work.

To gain insight into what student fellows perceived they learned from participating in the project, Rosalie conducted interviews with eight student fellows during June and July 2021. This sample group accounts for about 21% of core

participants (eight out of 38 student fellows). Summarized in **Table 2**, the students were purposefully selected for interviews because they had had an intensive engagement with the project (spending 5–15 h per week over the course of 4–18 months) and represented a cross-section of core participants in terms of their intersecting personal identities⁸, disciplinary background, and level of student (transfer or 4-year undergraduate, masters, or PhD). Furthermore, the eight students worked on the project at different times across 5 years, such that the types of activities they undertook and primary object of inquiry—the full campus foodscape or one to four specific nodes—reflected different life stages of the overall cycles of project inquiry (e.g., early visioning, intensive data collection, mapmaking, development of policy, and advocacy work). Each student had also continued to stay in touch with Rosalie and/or Alastair, even after each had graduated from Berkeley, and all had expressed in prior exchanges that their participation in the Foodscape Mapping Project had a lasting impact on them. All interviewees agreed to have their full names used in this article, along with some personal background details outlined in their own words (see **Table 2**). The interviews do not, therefore, capture learning that did *not* happen, or the experiences of students for whom the project was less meaningful. While the interviewees did express areas for improvement (see Critical Reflections, below), further analysis would be necessary to address instances of non-learning.

Interviews ranged from 50 to 75 min and were conducted by Zoom video calls. They were then transcribed by Rosalie with use of Temi speech to text transcription software. Interview questions covered students’ reasons for joining the project, how it compared to their other educational experiences at Berkeley, and what meaning-making they produced from their work on the project around food systems, JEDI, and learning itself. Interviewees spoke extensively about how the Foodscape Mapping Project fit into the broader ecology of their learning and careers. Rosalie also asked students about ways the project could have better fostered learning. Subsequently, we carried out content analysis of interview transcriptions and coded for forms and processes of expansive learning grounded in the pedagogical theories discussed just above. We used a combination of descriptive and process coding strategies (Saldaña, 2013) to categorize interview material for patterns regarding the kinds of learning manifested, the impacts of mapping work on student growth, and evidence of learning about JEDI and campus food systems specifically. We then triangulated these student insights with our own observations (as captured in historical artifacts of email exchanges and meeting notes) to produce an interpretative analysis of learning *via* foodscape mapping.

THE PEDAGOGICAL ENVIRONMENT

A key component of developing the Foodscape Mapping Project was leveraging campus learning structures outside

⁸The eight interviewees are a sample, and not comprehensive of the full diversity of core student participants: for example, for this article Rosalie did not interview Black, Indigenous, or Southeast Asian project participants who were also deeply engaged with the project.

TABLE 2 | Author and interviewee positions and identities.

Name	Position	Structure of engagement	Time on project	Academic program (major; minor)	Gender identity	Racial and/ or ethnic Identity	Domestic or international	Other salient identities
Rosalie Zdzienicka Fanshel	Professional staff; Doctoral student from 2019	Staff project director	2015–21 (6 years)	Berkeley Food Institute; Society and Environment	Non-binary female	White/Jewish	Domestic, in-state	Gay; Lower/working class
Alastair Iles	Professor	Faculty principal investigator	2016–20 (4 years)	Society and Environment	Male	White/Scottish	International from Australia	“Disabled:” deaf from birth
Joyce Lee	Masters and Didactic Program in Dietetics	Paid fellowship and coursework credit	2018–20 (18 months)	Public Health Nutrition; Dietetics	Cisgender woman	Chinese-Taiwanese-American	Domestic, in-state	First generation student; Low-income immigrant household who experienced upward social mobility
Alejandra Marquez	Undergraduate 4-year	Coursework credit	2019 (4 months)	Society and Environment; Data Science	Female	Latinx/Mexican	International from Mexico	
Selena Melgoza	Undergraduate 4-year	Coursework credit; student government position	Formally 2018–19 (10 months), followed by additional work in 2019–21 (20 months)	Society and Environment; Public Policy	Female	Latina/Mexican	Domestic, in-state	First generation student
Nathalie Muñoz	Undergraduate transfer	Paid fellowship and coursework credit	2017–18 (17 months)	Environmental Sciences	Woman identifying	White/ Mexican-American	Domestic, in-state	Bisexual; First generation student (siblings also went to college)
Will Payne	Doctoral	Paid fellowship	2017–18 (10 months) and 2020 (5 months)	Geography	Cisgender man	Non-Hispanic white	Domestic, out-of-state	Straight
Hortencia Rodríguez	Masters dual degree	Paid fellowship	2016–2017 (10 months)	Public Policy and International and Area Studies	Female	Latine	“Domestic” from Puerto Rico	Bisexual
Natalia Semeraro	Undergraduate 4-year	Paid fellowship and coursework credit	2017–2018 (17 months)	Nutritional Science; Food Systems	Cisgender woman	White/ European American	Domestic, in-state	
Dennis Uyat	Undergraduate transfer	Coursework credit	2017 (4 months)	Geography; Geographic Information Science and Technology	Non-binary male	Turkish Colombian	Domestic, in-state	Bisexual; Disabled

All interviewees agreed to have their full names used in this article, along with the details of their backgrounds they have chosen to share here. All identities in this table are in individuals' own words.

of conventional coursework to provide hands-on educational opportunities for students. These included paid undergraduate and graduate student fellowships through the Berkeley Food Institute, and undergraduate course credit through Berkeley's research apprenticeship programs, the Food Systems Minor community engagement capstone course (which BFI helped launch at the same time as the Foodscape Mapping Project), independent study research units, and honors theses. Students were recruited through BFI's weekly Food Systems Opportunities Newsletter and its network of 150 faculty affiliates, food-related student groups, social media, student affairs officers, and research program project calls. Sometimes project teams consisted of a hybrid of paid and course credit students, or students moved between paid and credit opportunities to meet their academic and financial needs. Providing paid fellowships was crucial to the project goal of increasing equity in access to food system learning. Berkeley's course credit-based research apprenticeship programs have historically marginalized students who are dependent on holding jobs while pursuing their education, as they are often not able to afford the luxury of taking credits beyond the minimum needed for their majors⁹.

Undergraduate, masters, and PhD students joined the project from fields as diverse as sociology, geography, society and environment, environmental economics and policy, public policy, development practice, public health, nutritional sciences, environmental sciences, molecular and cellular biology, urban studies, city and regional planning, and American studies. 38 students engaged in the project through what we call "core opportunities." They delved into 1–3 foodscape nodes, worked in teams of 2–4 students, and committed 5–15 hours per week over the course of 1–4 semesters. Between 2015 and 2020 during any given semester and summer, 2–4 teams were working simultaneously on Foodscape Map sub-projects. Building the map was thus modular in nature, with each team unearthing the intricacies of how issues of equity and inclusion radiated through particular aspects of the campus food system.

At the beginning of each semester, Rosalie made a basic scaffolding of a project plan for each team that outlined initial goals and learning objectives for the team to further develop together, and a tentative timeline of benchmarks. The project plans served as living documents: all members of each team edited the plans in weekly meetings to maintain a running set of notes throughout a project. Each session ended with identifying what the students wanted to accomplish by the following week,

pivoting goals and deadlines as needed to follow the threads of learning—often in dramatically different directions from where we had started. In this way, the learning structure embodied what Nabudere (2008) describes as the Freirean "sequence of action, reflection, questioning, researching hunches, drawing conclusions, evaluating options, and planning further action based on the learning that has been generated" (p. 70).

Throughout the semester the project teams paused for more substantial critical reflection. Through verbal discussions and end-of-semester written reflections Rosalie asked the students to consider both the content and process of their work, with starting questions such as: What has surprised you about the journey we've taken so far? What have you learned about the campus foodscape and issues of equity? What have you learned about yourself? Are there new skills you have exercised, and which skills would you like to develop further? Where would you like to see the project go next? What can I be doing differently as a mentor to better support your learning? The student-directed, flexible project plans and reflection activities aimed to enable what Gutiérrez and Larson (2007) call "expansive learning that transforms spaces" where learning is understood to be "the construction and resolution of the continually emerging contradictions in the practices in which people participate... [where we] not only make sense of contradictions, but also turn to authentic practices that initiate meaningful change" (p. 73).

Each semester's project foci were iterative expansions of work created in the previous semester. Often students decided to continue beyond their initial commitment, and new students were also recruited to build on projects that previous students had started, or to branch into directions that the previous teams had identified as important new threads. We have found that a minimum of two semesters (7–10 months of concentrated effort) makes for the most meaningful learning experiences—after 2–3 months students begin to deeply identify with the project, after which they are eager to follow through with longer cycles of iterative inquiry, described in detail under "Findings and Discussion," below. Another 132 students participated in "additional opportunities," which were shorter term commitments focused on either a data collection "blitz" performed through a large undergraduate course or extracurricular student group, or paid positions to visualize data collected by the primary students. The data visualizers worked closely with Rosalie and the primary students to translate the research into compelling graphics for the map website.

CYCLES OF RESEARCH AND ACTION: GREEK LIFE

Before we analyze the forms and processes of learning that the Foodscape Mapping Project enabled as a platform, we present here an example sub-project that provides insight into the cycles of inquiry and iterative project development that took place, as well as the structures of learning environments, research, and advocacy the project built. We also provide details on a second case, on grappling with UC Berkeley's exclusive beverage

⁹The Foodscape Mapping Project engaged students from 2016 to 2019 through the College of Natural Resources Sponsored Projects for Undergraduate Research (SPUR) and College of Letters and Science Undergraduate Research Apprenticeship Program (URAP). Both programs are designed for undergraduate students to gain research experience through close collaboration in a small team with graduate students, faculty, and (less typically) professional staff. Participation is through competitive application and students receive upper division independent research course credit. A small stipend is provided to the faculty lead to support project expenses, but students themselves are unpaid. Undergraduate and graduate students in the College of Natural Resources have been demanding reforms to the SPUR program to provide living wages for students so as to make the programs more accessible to minoritized students. See for example: Environmental Science, Policy, and Management Graduate Diversity Council (2020).

contract with PepsiCo, in the **Supplementary Materials**. Greek Life emerged as a priority area for advocacy and program development during strategy sessions in September 2018, at which five student fellows and three staff and faculty team members reviewed recommendations in the policy report released earlier that year. The work on Greek Life is exemplary of the processes we undertook for other foodscape nodes explored through the project.

Approximately 3,400 undergraduates are members of CalGreks, the UC Berkeley community of 50 fraternities and sororities (ASUC and LEAD Center, 2021)¹⁰. Almost 12% of undergraduates participate in Greek Life, yet fraternities and sororities were largely ignored as part of the campus food system. Inequities based on race, class, gender, sexual orientation, and religion have been structurally built into national Greek organizations since the first fraternity was founded over 250 years ago, and are the topic of much academic literature on JEDI and student experience in higher education (e.g., Hughey, 2010; Jozkowski and Wiersma-Mosley, 2017; Gillon et al., 2019). Exclusion of non-whites and non-Protestants was legally sanctioned in Greek Life until the 1960's, and students of color still face formidable barriers to belonging in historically white organizations. Anti-Black, anti-Mexican, and anti-Asian racism, sexual assault against women, condoning of rape culture, anti-LGBTQ+ hate, and hazing deaths at fraternities and sororities have repeatedly made national headlines in the last decade.

At UC Berkeley, recent cases of misogyny, racism, and homophobia in CalGreks have engendered multiple op-eds in the student newspaper, *The Daily Californian*, calling for reform and boycotts of Greek organizations (Muir, 2015; Editorial Board, 2018; Estacio, 2018). In 2016, Berkeley's Panhellenic Council, which represents historically white sororities, introduced a "community development" role to address diversity and inclusion. Yet the 2017 inaugural training required by all chapters prior to fall recruitment was heavily edited at the last minute, without the creator's permission, to make language on implicit bias, racism, and the LGBTQ+ community less "strong" (Kim, 2017).

Against this backdrop, in the 2017–18 academic year, the Foodscape Mapping Project sought to understand how students' experience of equity and inclusion in Greek Life intersected with their food experiences. UC Berkeley has four Greek councils: the Intrafraternity Council (IFC: 30 fraternities, mostly historically white), the Panhellenic Council (PHC: 14 sororities, mostly historically white), the Multi-Cultural Greek Council (MCGC: 14 culturally-based fraternities and sororities), and the National Pan-Hellenic Council (NPHC: 6 historically African-American fraternities and sororities). Rosalie created calls for interested students to join a new research project through Berkeley's undergraduate research apprenticeship programs, in return for course credit that Alastair provided. After selection interviews, one student participated in the fall semester and four in the spring semester: three PHC members, one IFC member, and one MCGC member. Later, two advocacy fellows were recruited to build

upon these research efforts. Collectively, the students represented both diversity within the Greek system and its dominant white culture: four white women, one Latina woman, one Latino man, and one Asian non-binary transgender woman.

After lengthy discussion, the research fellows chose to conduct comprehensive surveys targeted at both members and chapter presidents. Those surveys were the first systematic attempt to collect demographic and identity data among CalGreek participants, let alone their food experiences¹¹. Thus the project was a novel research venture aimed at generating data to illuminate a neglected part of the campus foodscape. Drawing on their own knowledge, the fellows recognized that chapter presidents might know much more about how fraternity and sorority houses managed their own food infrastructures, while members might know much more about their everyday experiences of food (e.g., diets, the ability to cook, or fears around food-related behavior). Moreover, it was important to distinguish between different groups of Greek members, rather than treating them homogeneously. Surveys also offered the opportunity to answer anonymously and confidentially in a context where responses might be very sensitive. Nonetheless, the fellows did not have previous experiences or skills in designing, disseminating, and interpreting surveys. With our mentoring (Rosalie provided the majority of everyday input, while Alastair helped with feedback on question design and distribution plans), the students learned how to draft, pilot, and refine the surveys. In the first semester we tested the surveys, followed by scaled up data collection in the second semester, allowing plenty of time to understand the challenges, devise strategies, and generate data for use in the map.

The member surveys asked up to 67 multiple choice and open-ended questions about student demographics and identities; reasons for participation in Greek Life and their particular fraternity or sorority; the structure of the housing and food options for their organization; and their thoughts about their food experiences. The chapter president surveys added 20 multiple choice and open-ended questions about number of members; cost of membership and financial aid options; use of membership fees; chapter efforts related to diversity and equity (including acceptance of transgender and non-binary members), and more detailed questions about the structure of house kitchens and meal plans.

Critically, the fellows had to develop a workable process for distributing the surveys in a situation where fraternity and sorority houses were not necessarily friendly to the idea, or cooperative with each other. In their weekly meetings and frequent email and text communications (alongside our advising), they dealt with numerous obstacles, from how to reach members and chapter presidents, to how to increase lagging response rates, to how to respond to push-back from skeptical marginalized houses. Sometimes they could not find a solution. Outreach efforts eventually included emails to every member of CalGreks from the Berkeley CalGreks staff advisor, fliers posted in fraternities and sororities with physical houses, presentations

¹⁰In 2017–18 when the Foodscape Mapping Project was initially conducting research at CalGreks there were 3,600 members and over 60 recognized chapters.

¹¹Per personal communication with Jeff Woods, Director of Fraternity & Sorority Life and LEAD Center Associate Director, UC Berkeley, March 6, 2018.

at weekly chapter meetings, social media, personal networking by project fellows, and a competitive incentive of a free pizza party by the organization who had the highest percentage of survey participation. Ultimately, 387 students responded (or 11% of CalGreek members), but major differences in response rates revealed inequalities (274 for PHC, 107 for IFC, but only 6 for MCGC, and 0 for NPHC).

The fellows explained this pattern as follows: As majority white organizations, virtually all PHC and IFC chapters have houses on UC Berkeley's "Fraternity Row." The MCGC and NPHC chapters, which specifically serve students of color and LGBTQ+ students, mostly lack chapter houses, undermining their "legitimacy" in Greek Life through physical marginalization from Fraternity Row and also limiting members' ability to access and share meals as a community. A fundamental housed/unhoused divide among campus chapters reflected the racialized, gendered, and economic inequities between Greek organizations at both the national and local level.

The fellows also generated data from the historically white chapters that suggested vast discrepancies between the food experiences of female and male students¹². One hundred percent of sorority respondents had a house meal plan with professional "house moms" and chefs that oversee operations; however, 93% were not allowed to access their kitchen even though they wanted access. In contrast, 93% of fraternity respondents did have kitchen access but only 43% had meal plans. Of the 57% without meal plans, 74% wanted them. Areas of top concern for sorority participants were the health of their diet, eating disorders, and lack of autonomy over their food. In contrast, fraternity participants worried about poor kitchen quality (lack of hygiene and functioning equipment) and ability to interact with each other over meals. The gender-based divergence in the food experience of CalGreek members reflected a self-perpetuating cycle of historic conditions that structured both their material food options and expectations of their social behavior. Another significant finding was that while 32% of sorority and 43% of fraternity respondents skipped meals because they did not have enough food and/or money, only 4% of sorority and 21% of fraternity respondents used UC Berkeley's extensive food assistance programs.

After analyzing these data, the fellows created recommendations for the Foodscape Map and policy report. We proposed requiring chapters to collect demographic information about their members so as to create a baseline for evaluating diversity, equity, and inclusion, and forming a Greek Food Policy Council. The students envisioned several functions for the Food Policy Council, including providing opportunities for members to connect over shared meals in students of color-friendly, gender-inclusive communal spaces. Cooking workshops should be held for members of all Greek chapters.

¹²Only one IFC respondent identified as gender non-conforming. This compares with 4% of Berkeley undergraduates overall who identify as transgender or gender non-conforming (Office of the Chancellor, 2019), speaking to the hegemonic gender binary of Greek Life. By contrast, three out of six MCGC respondents were gender non-conforming—all were members of Berkeley's two LGBTQ+ chapters.

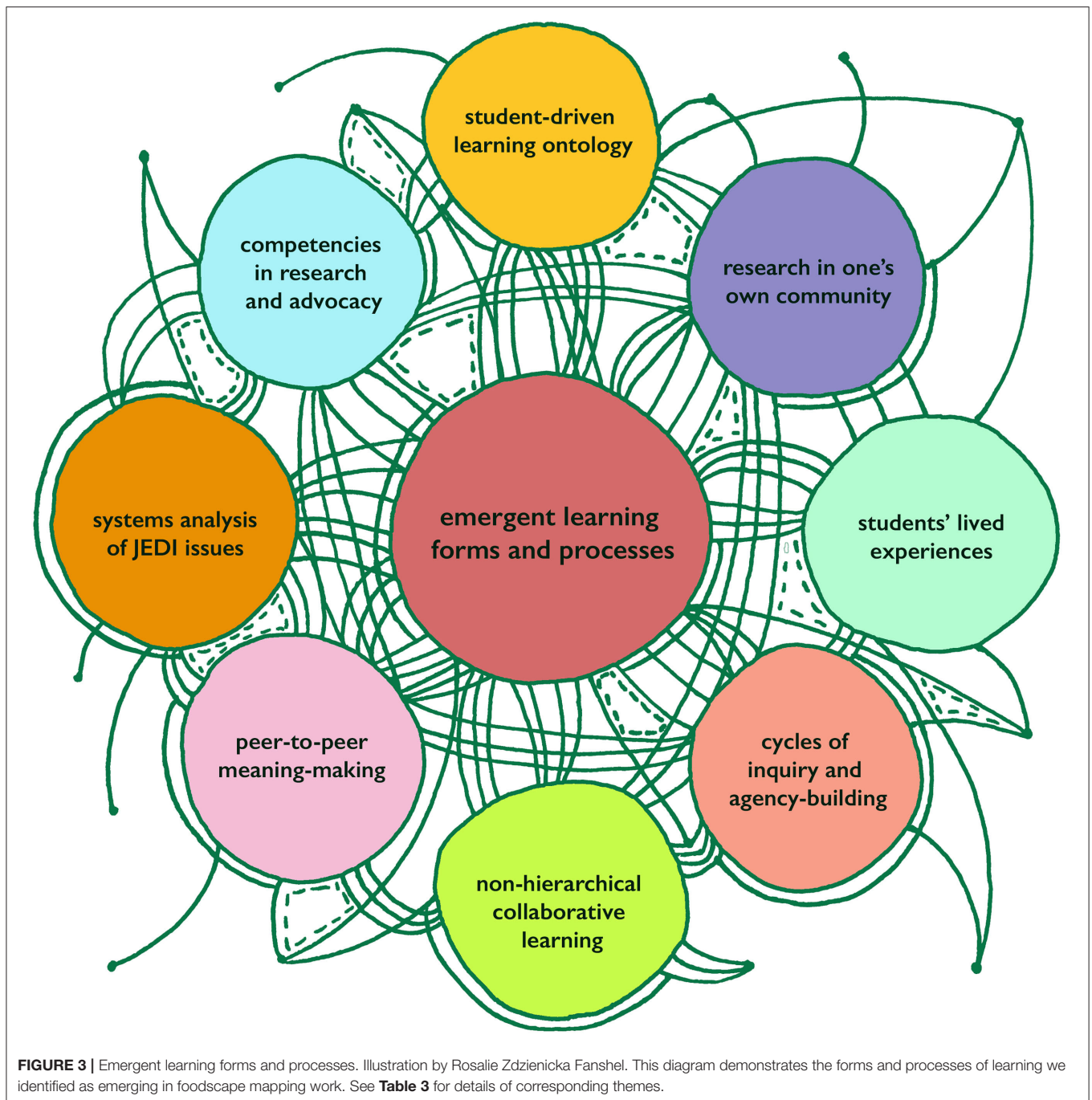
A taskforce of MCGC and NPHC members could learn about, and act on, how Greek system structures affect their access to food, including barriers to obtaining chapter houses. The council should also raise awareness about, and destigmatize the use of, campus food assistance programs in Greek chapters (see the full recommendations at: <https://food.berkeley.edu/foodscape/student-leadership/greek-life/>).

In 2018–19, Rosalie and two new project fellows, both in PHC sororities, worked to turn the recommendations into action. We presented the recommendations to the staff director of CalGreeks, the staff liaison to CalGreeks at the campus health services, and presidents of each council. The fellows created fliers about campus basic needs resources that were hung in every chapter house and presented by health workers appointed at each chapter. We also piloted two community meals at which we presented research findings and created space for participants to discuss food issues within the CalGreek communities. Many attendees reported that it was the first time they could openly discuss financial pressures to eat out, eating disorders among fraternity brothers, and the cultural agreement to spend their membership dues on alcohol instead of food. Ultimately, national level policy and financial inequities, such as which organizations can afford properties, appeared an insurmountable challenge for creating structural change at the local level. Yet the Foodscape Mapping Project's work to improve equity within the CalGreeks food system has had durable outcomes. Greening the Greeks, a pan-council organization focused on sustainability and environmental justice, has absorbed many tasks of the envisioned Food Policy Council. Attendance at Greening the Greek workshops are now mandatory for PHC and IFC members, and students report that the events are genuinely reflective and engaged spaces¹³.

FINDINGS AND DISCUSSION: EMERGENT LEARNING FORMS AND PROCESSES

We next investigate how the Foodscape Mapping Project functions as a multidimensional learning platform, drawing on the principles of critical pedagogy, expansive learning, sociocritical literacy, and justice-centered science pedagogy that we reviewed earlier. Based on our coding of student reflections and follow up interviews conducted in mid-2021, we identify at least eight learning forms and processes that the project manifested (see **Figure 3** and **Table 3**). Our analysis combines both results and discussion. Together, these forms and processes of learning comprise an interpretative framework that can be applied to build or study other campus mapping efforts and to campus food pedagogy more generally. By paying attention to these forms and processes of learning, scholars and practitioners can configure campus food pedagogical experiments to better design for meaningful student learning. We purposefully articulate the learning in students' own words.

¹³Per personal communication with Selena Melgoza, 2018–19 Foodscape Map fellow and PHC member, June 22, 2021.



Importantly, the project also resulted in substantial learning by staff, administrators, and faculty, as well as by map users. However, for this article, we focus on the experience of students.

Cultivating a Student-Driven Learning Ontology

Student fellows repeatedly noted that the project cultivated a vastly different learning ontology from their academic programs. At UC Berkeley, undergraduate students typically participate in courses with large enrollments (60–300), rarely interact directly

with graduate students except as instructors in course sections, and seldom engage with faculty outside the classroom. Students also encounter learning environments modeled on the traditional lecture format, even if this may be occasionally tweaked to be more interactive or “flipped around” (i.e., students doing some teaching through class exercises). They may never join a faculty-led research project during their time on campus; if they do, their work is usually dictated by the professor’s agenda. Learning through experience, where both topics of inquiry and research design are student-driven, is not a widely valued pedagogical

TABLE 3 | Emergent learning forms and processes.

Emergent learning forms and processes	Description
Cultivating a student-driven learning ontology	Whereas most university education emphasizes top-down, professor-designed, large-scale learning environments, the project favored small teams with shared leadership between undergraduates, graduate students, staff, and faculty
Enabling students to do research in one's own community for their learning	The ability of students to do research in and for their communities on campus was empowering and motivating
Legitimizing students' lived experiences through data collection	Students often felt immediate, visceral connections between the data they were collecting and their own journeys in navigating JEDI issues on campus
Catalyzing cycles of inquiry and agency-building	Through interrogating discoveries and roadblocks during research team meetings and identifying next steps together, students developed an investigative lens through cycles of inquiry, and built new agency as a result
Designing for non-hierarchical, collaborative learning	The project worked to build learning environments that fostered students-driven collaborative decision-making, the growth of student expertise, and peer-to-peer exchange
Nourishing extended peer-to-peer meaning-making	Students pulled in their peers through informal conversations about their research and the project, which helped to test findings-in-the-making
Enabling students to do system analysis of JEDI issues at both campus and societal scales	The project encouraged students to situate their learning about the JEDI issues in the campus foodscape into much larger food systems that universities are nestled within
Developing competencies in research and advocacy	Students acquired practical skills they later applied to other critical food systems work on campus and their unfolding careers

approach. For professional degree students, their studies include smaller classes and some research, such as master theses or capstone projects. Yet, they are also largely confined to content that is delivered in an one-directional, top-down way.

In contrast, fellows underlined the benefits they gained from being part of a project based on small teams with shared leadership between undergraduates, graduate students, staff, and faculty. Undergraduate Society and Environment student Alejandra Marquez commented: "It'll be a small group and it'll be graduates with undergrads together. I never had that type of experience before." She continued, "Developing an implementation plan... and just carrying out the entire strategy of how are we going to do it? What do the costs and benefits look like? How are you going to present it? Just carrying out that story and looking at all the parts of it. I think I learned more than if I had just taken a course like economics or financial modeling or whatever."

Hortencia Rodríguez, a dual masters student in Public Policy and International and Area Studies, reflected: "But there's also not a lot of opportunity in the coursework, at least that I experienced, for dialogue. Cause you were in sort of small seminar classes, or not even that small... which are structured based on lectures. You just listen to someone provide information to you, be

it a historical analysis or things like that." In common with some other professional programs, Masters of Public Policy students are required to complete a policy analysis project, ostensibly to acquire practical knowledge of developing policy ideas. Hortencia added: "[In the master's program] essentially you have a client, they have a really clear idea of what they want and you just need to provide the data and answer this really specific question. I felt that the Foodscape Project was so much more creative and there were so many more possibilities, because we were in such an early stage that we could explore what we wanted it to become."

Masters of Public Health student Joyce Lee describes how the projects research-advocacy nexus sparked a different kind of learning than she experienced in her other coursework: "I think what is true for both the [Staff] Basic Needs project that I was working on as well as the PepsiCo project was the fact that I was able to create research and really look at something, and then from there go into activism as well." Joyce synthesized data on Berkeley employment by job title, pay grades, local cost of living, and CalFresh eligibility, and then with the cross-campus Staff Basic Needs Working Group developed and delivered customized outreach programs to food insecure staff. Actually interacting with Berkeley staff in need was crucial to Joyce's learning. She said, "Even as a graduate student, you might just be on the side of research more, and you don't really have either the time or even the context or the resources to be able to bring that over to the people that you do want to serve." Alejandra, Hortencia, and Joyce are each describing a problem-posing learning ontology.

Enabling Students to Do Research in One's Own Community for Their Learning

Student fellows consistently mentioned the ability to do research in and for their communities on campus empowering and motivating. Even if students have the opportunity to do research as part of their assignments, this activity is to meet course specifications and may have very little relevance to the students' everyday lives. Students are routinely alienated from their communities through being encouraged to follow academic practices of impartial and "removed" knowledge-making. They can be disincentivized from pursuing a more meaningful educational pathway and may only seek to complete their degrees to gain credentials. By contrast, if students can derive practically and politically meaningful results from their research, they are much more likely to engage deeply with their educational experiences (Freire, 2018). Learning is more likely to happen during participation in activities that students value (Gutiérrez and Larson, 2007).

At the time Selena Melgoza first joined the project, she was an undergraduate Society and Environment major participating in Greek Life. She initially did not know anything about her house's food procurement but the project awakened her awareness of the inequalities of food access and decision-making that her community faced. Working on the CalGreeks survey project made her feel like she "had a huge stake in the results and the outcomes of what we were studying and what we wanted to do.

Being in Greek Life and learning how the food works, and who gets food and who doesn't get food and... how do we talk about it?" She took this insight into her work on healthy beverages, as she connected how student food choices could be limited by campus policies lacking transparency and accountability. The potential to make positive changes through the project motivated her to deepen her learning and to discover that the map could be profoundly relevant to her community's well-being. "And then the same with the PepsiCo: like, I don't really have a say in this, and also the rest of the campus doesn't even know that this is the contract. I feel like this is my chance to make something happen, and it's something that really needs to happen. As a student, I could obviously benefit from these changes and every other student could also benefit."

Undergraduate Nutritional Science major Natalia Semeraro, who studied the accessibility of campus gardens to a diverse range of students, felt a much stronger connection to her learning because it was about spaces she already participated in. She said: "[The map] was really cool and something that was really needed. Cause everyone was like, 'I don't understand, there's all these gardens?' It was really directly related to what I was doing in my job for CalDining, because I was managing a garden. So to me that felt super relevant and it all made sense. It visually makes sense. But we also had to figure out: How did we want it to be visualized in a map? What information did we really need? And how could we get it from all those different gardens?" Natalia's deep investment in the campus gardens community guided her in developing the research design.

Students were excited about learning something they could immediately put into practice in their communities. Selena found: "I went into this and I was like, 'Oh my God, you can learn something and then actually apply it right then and there!' So I think that really changed my whole perspective on what kind of research I would even want to do. Community participant research is super fun and exciting. There's so much value in that. Working with communities that you're actually trying to make the change in, I think is super important and something I still want to continue doing."

Legitimizing Students' Lived Experiences Through Data Collection

Reflecting a justice-centered pedagogical framework, the Foodscape Mapping Project prompted students to examine socio-scientific problems of importance to their own lives and those of their close communities (Morales-Doyle, 2017; Davis and Schaeffer, 2019). Students often felt immediate, visceral connections between the data they were collecting and their own journeys in navigating JEDI issues on campus. The findings helped them better articulate their personal experiences and offered legitimacy to student knowledge production and activism. For two project fellows who were also active in the Students of Color Environmental Collective¹⁴, data collection for

two different foodscape nodes resonated with current concerns of the Collective. Undergraduate Environmental Sciences major Nathalie Muñoz conducted semi-structured surveys with participants in food-related extracurricular groups that revealed that their members were wealthier and with a higher percentage of female, white, and Asian students than the Berkeley student population at-large. The surveys also showed a low level of critical self-reflection in the groups about their lack of diversity. Nathalie commented: "I mean, at that very same time that we were working on that project, students from the Students of Color Environmental Collective were getting the cops called on them for going into Mulford [a campus building] because they put up a sign that said 'Where are the professors of color?' on top of the very white wall of [photos of] professors. So it gave more weight to the numbers that we were seeing, and it helped create more of a story behind the information that we were collecting."

Undergraduate Geography major Dennis Uyat reflected that learning how previous student activism helped shape campus structures gave them hope: "It was the first time that I actually did in-depth research. Going to the library, fishing for really old texts about the University, and trying to piece together this timeline really helped to inform how the [Campus Food Players] power map came to be. Learning about the history of UC Berkeley... and just reading about how the forestry department came to be as a result of student efforts was really encouraging, personally. What I wished after learning that is the Students of Color Environmental Collective, if we had been more strategic in demanding maybe even a department of environmental justice, because if that's how forestry came to be—like relevant issues, like environmental justice or food justice."

The students were not just learning about the campus foodscape through their research—they were transforming their food-related experiences into something that *could* be talked about. Selena Melgoza articulated this realization: "But recognizing at the same time, these institutions weren't designed for people like us in the first place. And like, that's a whole radical, revolutionary kind of idea. How do you tackle that?" The direct connection students made between foodscape research and their own experiences of marginalization demonstrates a sociocritical literacy (Gutiérrez, 2008). As they develop critical consciousness (Freire, 2018) of their role as historic actors in the campus foodscape, students can arrive at an emergent agency that inspires them to take action.

Catalyzing Cycles of Inquiry and Agency-Building

The responsive structure of project meetings, which were designed to interrogate discoveries and roadblocks during the previous week and identify next steps together, was conducive to students developing an investigative lens through cycles of inquiry, and building new agency as a result. Selena Melgoza described the weekly cycle as follows: "Because once we look at something, we were like, 'What's going on?' And then a bunch more questions keep coming. Then we just keep answering them

environmental racism and justice" (Students of Color Environmental Collective, 2021).

¹⁴Founded in 2016, the UC Berkeley Students of Color Environmental Collective "is a space for students of color to seek refuge from white-dominated environmental and social justice spaces, to learn more about the intersections between environmental and social justice, and to foster conversation about

and then more questions arise and then we keep answering them.” Selena is relating her experience to what Gutiérrez (2008) calls learning in which “the individual and her sociocultural environment actively seek to change the other to their own ends” (p. 153). Inquiry was never separate from the overarching question of, “What are we going to do about it?” which Rosalie frequently posed to students. Throughout the project, Rosalie was struck by how students would respond: “Okay, we say we want to do that. Let’s make it happen! What are we going to do to make this happen?”

During cycles of inquiry, students both felt this voracious fearlessness and were overloaded, as they toggled between a focus on micro level issues and connecting with larger structures of power and historical and sociopolitical formations of the U.S. food system. Hortencia Rodríguez, who worked on the project at an early stage when we were deciding which spotlight maps to pursue, reflected: “I have to say, the more that you learn it’s a little overwhelming. Cause you’re like, ‘Whoa, there’s so much going on. There’s so much that’s connected.’ And then you have all of these intersecting issues where it’s labor rights, how you select vendors, what are the campus boundaries?” It was in these daunting moments that expansive learning occurred—that is, when the students collectively figured out their goals and object of inquiry (their activity) at the same time that they were implementing it (Engeström, 2001; Engeström and Sannino, 2010). Joyce Lee described the process of developing proposals in the beverages case design course as such: “We came up with an idea and I was like, ‘Wait, I don’t think we can move forward with this. So let’s come up with another idea too.’ So it’s just being able to come up with many brainstorms and move pretty far along with them, and then being like, ‘Oh, wait, let’s see what else we can do. Cause this might not work out as well as we thought.’” Here, the students are learning they *can* ask their own questions, and that these questions need to come from many angles. They are learning how to frame, answer, and evaluate questions within a vertiginous, open-ended problem space.

Both Selena and Joyce also used the term “snowball effect” to describe their learning experiences. They were part of a four-person mixed undergraduate and graduate team that joined the project after release of the policy report in 2018. Their first task was to decide which foodscape nodes to pursue for further research and advocacy. Joyce explains: “So Selena, Alex, Isa, and I were just trying to figure out what we wanted our priorities to be. Then as a group, we found the PepsiCo contract to be very interesting, we decided to go forward with that... Then from that, I feel like we just snowballed into a bunch of other really great programs too.” Similarly, Selena described the process of developing the community meals and peer-to-peer workshops in CalGreeks as follows: “It’s like a snowball effect. I feel like we just started with this one idea. We had those brainstorming sessions and then we made it happen. I think at the time, we didn’t really know how exactly these things were going to pan out. But while working together, [my team mate]...knew everyone at Hillel. She had that connection and we used that to our advantage, then we met more people at these community events, and they’re like, ‘Oh yeah, we could have this at our fraternity next time.’” The snowball metaphor

reveals the students’ experience of learning as a collective, active, improvisational, and sometimes unwieldy undertaking. They adapted to their rapidly changing understanding, and decided what pathways they would try following.

Designing for Non-hierarchical, Collaborative Learning

Peer-to-peer, non-hierarchical knowledge-making is rare in formal higher education, especially at an institution like Berkeley, where incoming 1st year undergraduates have a 18% acceptance rate and an unweighted/weighted grade point average of 3.86–4.0/4.27–4.62 (on a scale of 4.0; Office of Undergraduate Admissions, 2020). While the Berkeley Center for Teaching and Learning emphasizes the importance of teamwork (Ciston, 2015), Berkeley students are trained to compete with each other and focus on individual achievement from before their arrival and throughout their Berkeley education. Simultaneously, they are seldom treated as knowledgeable experts in their own right, except when it comes to matters of “student life.” Faculty are seen as the primary experts and makers of knowledge on campus.

The Foodscape Mapping Project’s guiding principle was democratic knowledge production: we strived to build learning environments that fostered students-driven collaborative decision-making, the growth of student expertise, and peer-to-peer exchange. Whether students were participating *via* course credit or paid work, we deliberately designed spaces where each had equal power in steering the project. We emphasized strengthening of competencies through practice (see further below) and greater confidence in being active knowledge-makers, not just passive recipients. Project fellows commented that the level of collaboration was unique in their Berkeley education. Natalia Semeraro observed: “I was like, ‘This is so cool because this work was a complete collaboration.’ We did this part, they helped create the visualization of it. None of it could have happened without all the people that we talked to make it happen. I think I learned a lot about how—it seems so simple, it should be obvious. But when you’re in school, these projects, you just start it and you do it and it’s your project. But projects really are... you actually need a whole team and a web of many people.”

This collaboration included pairing data collectors with data visualizers who, often working in shorter stints, turned in-depth social science research into actual maps. Many of the visualizers were in computer science and related fields and were excited to practice their coding skills to create animated graphics; in the process, they were exposed to thinking about food systems for the first time. Likewise, the social science students working on data collection were introduced to programming. Dennis Uyat, himself a skilled cartographer who created the draft Campus Food Players visualization, reflected: “One thing that was really cool about the [project] was there were different relationships that happened there in the campus community. Like every space on campus is everybody’s and it’s fun to see all the connections. I remember [Rosalie] paired us with the computer science student who programmed the Foodscape Map from the visual sketch to this other generative thing. I remember that experience just being so cool, because not only were we paired with the computer

science student, but also a PhD student who had both a CS and theoretical and visual arts background.”

The mixing of first-year admits and transfer undergraduates, masters, and doctoral students was deliberate, and meaningful for students at all stages of their education. Alejandra Marquez commented about being on a team with masters students: “In the time that we were working, feeling that I had very unique perspectives and that I could also bring my own expertise, even though they were higher up in their education. That was very cool to just build my confidence, and where the team was with people that had other levels of knowledge, but also feeling like I’m bringing something that is valuable.” This learning was multi-directional. Will Payne, then an advanced doctoral candidate in Geography (now Assistant Professor of Planning and Public Policy at Rutgers University), remarked: “I’ve supervised for my own research now a number of undergrad and graduate student researchers. I think some of the way that I work with them is informed by the Foodscape Mapping Project. Seeing how we do things that are relatively bounded tasks that build into something bigger and working with [students] to figure out what they’re going to be most excited about or most align with what they want to do that also moves the project forward.”

Teams were also consciously formed to bring together diverse students in terms of personal identities, life experiences, and disciplinary knowledge. During interviews to join the project, students were asked about their prior background in anti-oppression work: that is, in recognizing and understanding the intersecting ways people can experience oppression and marginalization, critically analyzing the social structures of power and privilege, and then attempting to mitigate their effects and equalize power imbalances. With JEDI issues as the core of the project, at times racial dynamics between students—and between students and Rosalie and Alastair as white project director and PI—needed to be explicitly discussed and negotiated so as to keep an honest focus on recognizing and upending embedded power. Simultaneously, we had to acknowledge that our official staff and faculty positions on campus could never be disentangled from student perceptions of our power. Eighty percent of project participants were students of color, many of whom were additionally minoritized as LGBTQ+, first generation, and/or having a disability. As an example of one such dialogue, during the 1st year of the project, two Latinx and one Southeast Asian undergraduate fellows requested that a workshop be held for students of color only, which they would organize under the mentorship of a Black doctoral student fellow. Rosalie and a white doctoral student fellow provided logistical support but did not participate in workshop design or attend the event.

hooks (1994) encourages mentors to bring their full selves into the learning environment: “When professors bring narratives of their experiences into classroom discussions it eliminates the possibility that we can function as all-knowing, silent interrogators. It is often productive if professors take the first risk, linking confessional narratives to academic discussions so as to show how experience can illuminate and enhance our understanding of academic material” (p. 21). Rosalie was frank with students about her positionality: openly acknowledging her

cognitive biases as a white person while sharing that she is Jewish, queer, and from a working class family with a homeless parent—that her own interest in the Foodscape Mapping Project stemmed from parental experience with food and housing insecurity and feeling that she did not belong in higher education. In addition, Alastair is the only born-deaf professor at UC Berkeley (out of over 1,500 faculty) and has wrestled with access to higher education, both as student and as faculty, for decades. Dennis and Nathalie Muñoz both said that when Rosalie shared her queer identity it created a vulnerable space where they too felt comfortable to publicly identify themselves as queer.

In our (Alastair and Rosalie’s) own reflection, we recognize that Rosalie’s role as project director from her positionality as a staff member—rather than a faculty or graduate student instructor—helped foster the non-hierarchical learning environment. Few students have worked closely with university staff members in a research or curricular setting. Rosalie purposely framed herself as a “non-expert”: while she had worked for the university since 2008 after a decade in nonprofit food systems work, she did not have an advanced degree¹⁵. This disruption of typical instructor-student roles helped frame the learning environment as equally exploratory for everyone.

Nourishing Extended Peer-to-Peer Meaning-Making

Beyond the project teams, fellows expanded their meaning-making by discussing the Foodscape Mapping Project with peers in other settings. As discussed above in regards to *teatro campesino* in farmworker activism and the Highlander Research and Education Center, peer-to-peer learning has long been at the center of agri-food systems social justice movements in the U.S., as well as worldwide. Hortencia Rodríguez explains how the Foodscape Map served as a nexus for her and her peers to integrate learnings from myriad food-related encounters on campus: “The way that I think of learning, when you’re in a classroom, yes, you’re learning, but you’re also learning when you’re just hanging out with people and participating in events and going to student organizing meetings. But perhaps you don’t realize that until you come together and debrief it... and you’re like, ‘How about that meeting? That was interesting.’ And then you’re like, ‘I hadn’t thought about it that way.’ You internalize different perspectives and new perspectives through that kind of conversation. I feel like the Foodscape Mapping Project was an opportunity to do that with an explicit objective. It was thinking about it as a system.”

Through community workshops and public town halls, students gained skills in formally presenting their research findings to peers (as well as faculty and administrators), at times to audiences who were unfamiliar with academic language around food systems such as in the Greek Life workshops described above. Students also took the opportunity to extend

¹⁵In 2019 Rosalie enrolled as a doctoral student—with Alastair as her advisor—while concurrently continuing her staff position at the Berkeley Food Institute. Therefore some Foodscape Map students worked with Rosalie in her dual role. Rosalie’s doctoral work grew out of the Foodscape Mapping Project; the project thus provided an educational opportunity even for its staff director.

their learnings by discussing the project with their friends in informal settings. Alejandra Marquez recalled of the PepsiCo work: “Not only were we having this great learning environment and doing all this strategy and learning so much, but it was for something that was happening around us and other students really cared about, that I could talk to my friends about. It impacted all of us.” Nathalie Muñoz added that through discussing the project with her friends outside of food systems studies, she gained new insights: “It pulled my head up to think about all of these other bigger things. The way that I would talk about what I was doing with my time in this project with other people, that was also another place of meaning-making for me. Talking about it with my peers and really putting all of it into perspective for me in terms of what you can do with the research and how big it really can be.”

These dialogues in turn became an extended community peer review of sorts that informed the evolving directions of the Foodscape Map. In exploring how contemporary scientific practice addresses technological and ecological risks by producing “post-normal science,” researchers in Science and Technology Studies have proposed the concept of extended peer review (Funtowicz and Ravetz, 1993). Because post-normal science tackles uncertain topics with significant policy and material impacts, peer review should include *all* the stakeholders found in a given issue, to assure high quality results. For example, in researching chemical risks, researchers should include community members, corporate managers, and policy-makers. In terms of foodscape mapping, fellows pulled in their peers as they did their research, to test findings-in-the-making.

Selena Melgoza described this extended peer review as a crucial part of developing the strategy for the Pour Out Pepsi campaign, an activism project she initiated *via* student government inspired by her time on the Foodscape Mapping Project: “Then I was like, ‘Do you guys have any ideas? Like what is your experience?’ I think learning from [my peers] as well because I felt like sometimes even with PepsiCo stuff, I’m like, ‘Oh, I have all this information and this is what we should do.’ Then someone from an outside perspective is like, ‘Oh, well what is this?’ And then you’re like, ‘Oh wait, I didn’t think about that because I’ve just been clouded by all the information that’s already in my head.’”

Enabling Students to Do System Analysis of JEDI Issues at Both Campus and Societal Scales

Using systems analysis of the campus foodscape, the project enabled fellows to enrich their knowledge about food systems and JEDI more broadly. They were frequently highly motivated to join the project out of a strong desire to contribute to campus change, but diverged greatly in how much they knew about food systems as a concept prior to their involvement. Through their mapping endeavors, fellows came to greater understanding that in fact a campus food *system* exists, and thereby became better able to dissect how it works, who are the key participants, and what power relations exist. In tandem, students became substantially more cognizant of manifold JEDI issues, from

exploitation of largely minoritized food workers, to how race, gender, sexual orientation, and disability are determinants of access to education, gardens, and basic food security.

Importantly, the project was designed to encourage fellows to situate this learning in the much larger food systems that universities are nestled within. It attempted to introduce students to what Weis and Fine (2012) call critical bifocality, or “mak[ing] visible the sinewy linkages or circuits through which structural conditions are enacted in policy and reform institutions as well as the ways in which such conditions come to be woven into community relationships and metabolized by individuals” (p. 174). For example, in assessing how campus decision-makers frequently view urban agricultural research/production and housing as competing for “scarce” land, and thus can affect the environmental and economic well-being of neighboring communities (see the spotlight map on the Oxford Tract), students could relate campus topics to global land use issues they might learn about in coursework. Through the spotlight map that analyzed 100 years of UC Berkeley course offerings (see the spotlight map on Food and Agriculture Courses), students learned about Berkeley’s history of teaching eugenics and practices for overseas colonial resource extraction, for example, and were able to reflect on the University’s evolving visions of what the study of agriculture and food should include—and offer their own JEDI-based visions. In other words, the project helped pull back the veil on not just food systems, but higher education systems, and how the two intersect.

In the beverages case we discuss in the **Supplementary Materials**, fellows learned about the substantive features of the soda industry; its social, health, and ecological effects; and how soda companies manipulate agreements to control access to beverages on campuses and thereby harm student well-being, while simultaneously harming distant communities in the production chain. Fellows also learned about innovative policies that could put pressure on companies to abandon unhealthy products, along with viable business models for alternatives. Joyce Lee reflected: “As a public health nutrition student, a lot of the research that we read, a lot of things we focused on were things like the soda taxes that came from the research at Berkeley... But really just demonstrating how the beverage landscape itself had such a big impact on overall health and really being one of the leading contributors to obesity and obesity-related diseases like diabetes too, and be able to see what it was like at our specific campus as well.” She explained why the team decided to pursue the PepsiCo contract as an advocacy project: “Because as a student, you don’t really know what partnerships the school might have been with... After understanding the contract some more and really seeing who benefited from the contract, it made me think that as a student who is part of this community, why are we the targets of these advertisements or an exclusive beverage marketplace that only has certain products. Like why are we a part of this type of food system? Do we like the fact that we’re being privately sponsored by a conglomerate big soda company? Is this the norm, really?”

In terms of the campus foodscape, fellows were repeatedly astonished at how complex and ill-structured it actually is. Will Payne remembered, “I think I learned that through this project

at Berkeley is the overlapping constituencies and fiefdoms for different things... With the [Campus] Food Players map, I think that really kind of came into full vision of like, 'Oh, wow, these things just kind of sediment themselves and grow in weird ways.' It's not logical, if somebody just told you ahead of time, 'What office is this function in?' I don't think most people would guess right about Berkeley... about any university, because it's all path dependent." Without actually mapping power relations and flows of decision-making coursing through the university, people could not fathom who and what shapes the campus food system. For instance, Berkeley's 24 campus gardens are overseen by 14 different administrative structures, causing frequent confusion for students seeking employment and learning activities in these spaces, let alone advocating for expansion of garden-based opportunities. Faculty and staff nutrition and wellness programs—such as programs for campus employees with the highest risk jobs, which include food service—are embedded in University Health Services, which reports to Student Affairs, affecting funding priorities for services aimed at low-wage staff populations. Because of its historical status as the University's land grant base, the College of Natural Resources controls much of the food course offerings and agri-food research. This knowledge ultimately became incorporated into the Campus Food Players, an interactive power map that allowed users to reveal who were responsible for what facilities, academic units, service units, and student groups.

Importantly, fellows began to develop a sense of how a complex reality behaves as a "system" by trying to connect between all the parts of the campus foodscape they were learning about. Simultaneously, they built the foodscape map as a learning platform (Röling and Jiggins, 1998), by adding their various contributions and seeing what became visible. Hortencia Rodríguez mused: "So there were just a lot of things that I felt were sort of isolated but related initiatives, but there was nothing kind of like bringing them together in a cohesive framework. I felt like this was a really wonderful opportunity for me to think about it as a system... There are initiatives that are responding to different things, but we do need to think about it as a whole. I remember that meeting that we had with the catering and dining people and getting a perspective of sort of thinking about what are the vendors and how do they select vendors? That was just an area that I was like, 'Whoa, I hadn't even thought about this. Labor rights and what do we do with our restaurant workers?' That was just a whole other level that I wouldn't have really thought about unless I had participated in a project like this." For her, the campus foodscape was a microcosm of larger food systems.

Fellows also began integrating JEDI into their coalescing systems perspective. Instead of simply viewing specific cases of injustice in isolation, they understood these as examples of structural oppression working across history and time throughout the campus foodscape. Some (not all) students used critical race and feminist theory to articulate what they were observing. Dennis Uyat explained: "I feel like [the project] really put certain frameworks of white supremacy, all the isms, and patriarchy, et cetera. Like I had this framework and then put it all together in a praxis, putting that theory to practice. So I feel

like that was cool to see and execute and have the opportunity to do that."

Discussing access to gardens, Natalia Semeraro said, "With the gardens, there's always been in the project, but outside of the project too, a lot of discussion around power. I think this is related to student groups too. Like the University of California Botanical Garden is this institution, right. And how no one could harvest the food there. That was a super interesting conversation I remember that Nathalie and I had. Like, 'This is so dumb, this is the biggest garden when you look at it and nothing there is really going to feed anybody!' Super interesting. Then we have these little tiny gardens that are producing a good amount, but also are not allowed, really supposed to be on campus. There's the dynamics there. Then there's the oldest student garden, SOGA [the Student Organic Garden Association], which a lot of students felt not welcome there. Like they couldn't really be involved just the space and the people involved already were not really welcoming to everybody. It was like a very white space. So we talked a lot about that." Natalia is identifying what Bang et al. (2012) called "settled expectations" in STEM education, where white ontological and epistemological constructs have greater currency. Precarious students of color-led food gardens are juxtaposed with long-standing white-led spaces and powerful "scientific" gardens on the same campus. Access to these spaces is not only racialized but based on hierarchies of knowledge and practice. Scientific research on botany and ecology is valued much more by the campus administration and most faculty than experiential learning for urban agriculture, let alone achieving food security.

Developing Competencies in Research and Advocacy

By participating in the project, students acquired practical skills they later applied to other critical food systems work on campus and their unfolding careers. Because the project depended on primary research to inform the map, student teams developed new expertise in research design and methods. Students learned to discern which methods might support their research questions, often garnering skills in methods they had not used previously. Varying between specific sub-projects, these methods included: semi-structured interviews, oral histories, participant observation, semi-structured questionnaires, physical surveys of gardens and buildings, ecological cost-benefit analysis, legal and policy analysis, crowdsourcing observations, web and library searches, analysis of deidentified food pantry and health records, and content analysis of historical documents (see **Table 1**). Students also devoted many hours to appraising this data and figuring out how to visualize and share their findings in ways that would resonate with map users.

As a result, many fellows grew into experienced researchers adept at combining multiple methods. For Nathalie Muñoz, who did not have prior experience with social science research, the project broadened her whole idea of what research could be. "I enjoyed how much this project just completely blew open another door for what could be considered research for me. The idea of interviewing people as a form of research,

that wasn't really something that I had envisioned because I was coming from a hard STEM background of engineering." Nathalie worked on four spotlight maps across 17 months on the project, during which she learned skills in conducting oral histories, content analysis of big data sets, and survey design and execution. Students in the beverage case design course (see **Supplementary Material**) learned hard skills in systems mapping, stakeholder interviews, cost-benefit analysis, financial modeling, value proposition development, writing implementation plans, and crafting a pitch. For Alejandra Marquez, the systems mapping stood out: "I just fell in love with this type of systems thinking and just looking at all the components. Complex systems really are very interesting to me. And so I really loved the activity of systems mapping. That was I think one of the first things that we did that I was like, 'This is so cool. I want to learn more about it'."

Logically, map design was a fundamental area of skill development. As a PhD student, Will Payne joined the Foodscape Mapping Project for the opportunity to work on collaborative cartography. He commented that unlike typical doctoral work, he was motivated to "do something that was project-based that was going to not necessarily just result in a paper that one person would read. This was a chance to test out some of the mapping and visualization on something that was a group effort." Will highlighted that through the trial process he learned about the technical limitations of free versions of private software, which led him to redesign the Geographic Asset Map with all open source software. He commented that he will continue to use open source software moving forward, both as a philosophical choice and to manage public projects with small budgets. A few of the primary fellows, such as Will and Dennis Uyat, worked on both data collection and the visual (or auditory) map-making. For the 10 students who worked only on shorter-term cartographic projects, they gained skills in collaborating with data collectors on translating the research into meaningful visualizations, and building animated graphics that often stretched their previous technical know-how. Each map went through multiple iterations between the researchers and cartographers as the students worked out together a shared vision.

The students demonstrated that learning "hard" methods-based research skills happens alongside other key competencies in the critical nexus of food systems research-activism-pedagogy (Valley et al., 2020). Project management was among these competencies. What should the maps include? Which priorities should be pursued at a given time, leaving other topics for later? What constraints bound what we can realistically accomplish, and what can we creatively overcome? Asked about how she approached the initial design of the map, Hortencia Rodríguez said, "Okay, info gathering, getting myself up to speed. Then there was a phase of being like, 'Oh my god, this is a lot of information. How do we structure in a cohesive and logical way that you can convey in an interesting way without being overwhelming?' Then having to have a conversation about scope and being like, 'Is this within the scope of this project or is this something that we just name for others to investigate further?'... And I think that's how all of the derivative maps [spotlight maps]—also where we had to identify, this is the big map, but then even within these different topics and layers, there's

a whole other map... Those are universal skills, right. To think about systems in that way. And also just how to be in a project, basic project management skills and working in a team... that I felt were really valuable for me as well."

In our interviews, many students remarked that networking and stakeholder engagement was one of their biggest areas of learning: interacting with new peers, a wide variety of campus staff, and people in high authority positions on campus; facilitating meetings; and building confidence in speaking up. Reflecting on program development and coalition building, Joyce Lee said: "So essentially I feel like the whole experience was a learning experience for me because I had not been part of stakeholder engagement or coalition building in such a large way before. Through the [Staff] Basic Needs Working Group... I learned what a working group was and I learned how to make one successful. And I learned that when something became too big, when we had too many ideas, I learned how it was a good idea to effectively separate it into two focuses, such as the Policy and Advocacy Group or the Programming and Outreach group." In other words, students learned how to organize their work to have an impact.

Student leaders also shared their work in public forums: graduate students attended two off-campus conferences, and both graduate and undergraduate students presented at Berkeley town halls and workshops. Many students generated written products stemming from the map, such as a blog post about the healthy beverages course (Pfeiffer, 2020), op-eds about the PepsiCo contract (Solis and Melgoza, 2019) in the campus newspaper, and a report on beverage logo advertising and product mix availability on campus (Lee et al., 2020). Gaining competencies in project management, networking, and communication alongside research methods enabled students to turn the map into an effective advocacy tool in campus administrative politics that has garnered broad attention thus far.

Fellows reflected that the interwoven competencies they gained during their time on the Foodscape Mapping Project gave them hope and confidence for their future careers. Natalia Semeraro reflected: "One thing that was really helpful in figuring out or understanding what kind of work might be possible in food systems, because you don't know that necessarily just from some of the food systems classes, because they tend to get pretty specific on a topic like insect ecology or the nutrition classes... [They] don't really show you like what's actually possible. How else could you think about these things and make connections between the different topics? I think it helped me figure out, 'Okay, what are my skills relating to food systems? Where could I fit in potentially?'" Joyce added: "The way that this had been structured gave me a lot of optimism about my own future and in my own career that there is flexibility out there in order to do some of the things that I am passionate about."

CRITICAL REFLECTIONS: WHAT TO DO BETTER

The mapping led to not only the constitution of a new missing object (the campus foodscape) but also to diverse strands of expansive learning about food systems and JEDI. For the first

time, campus community members could actually grasp what its foodscape looked like, and begin identifying intervention points within the complex administrative structure to make change for racial and other social justices. While the cycles of advocacy and policy that the map project has initiated are continuing to build, it has already led to some concrete effects, such as the creation of new basic needs programming on campus specifically for campus staff¹⁶. Elsewhere, we have detailed the process by which the map took form, how students were recruited, what existing campus educational and research programs could be leveraged, and the funding that made it possible (Fanshel and Iles, 2020). Here, we briefly review important practical lessons—drawn from both our successes and shortcomings—to help guide campus foodscape mapping at other universities, according to their particular situations and needs.

Mentorship

Without intensive mentoring of students and a carefully structured process for managing teams, the project would not have succeeded. As students wrestled with navigating their amorphous problem space, they needed mentorship to develop doable cycles of inquiry and action, and to grow more confident in grappling with seemingly overwhelming data. Yet learning how to mentor proficiently and patiently took much time and effort—as did doing the actual mentoring work. Partly as a result, Rosalie carried a far too hefty workload as the project director, meeting regularly with multiple student teams each semester, constantly giving feedback on plans and work-in-progress, and overseeing the map's technical design. This was atop her existing responsibilities managing other BFI programs.

Mentorship scholarship emphasizes the importance of promoting a sense of social belonging in an academic community, especially for students of color (Griffin et al., 2020). This includes developing a circle of mentors who vary in their expertise, perspectives, positionality, and life experience (Montgomery, 2017). With majority students of color as project participants, yet a white person in the primary mentorship role, students did not benefit from a network that included mentors with overlapping racial identities. While a project's content may explicitly focus on equity and inclusion, creating a community of belonging is a distinct task. In addition to more effort on expanding a mentorship circle, we could have also been more intentional in specifically recruiting a greater number of Black and Native American students—two populations who are egregiously underrepresented at Berkeley.

We also discovered that mentorship was most supportive after at least two semesters, yet half the primary fellows only participated for one semester due to the structure of educational opportunities available on campus. Most of the shorter-term students indicated that they had significant learning experiences while participating in the project, but a few students did not, for a number of reasons. Data collectors had more meaningful

semester-long learning experiences than students whose roles were focused on policy and advocacy. Developing a depth of understanding of the complex foodscape and project ownership was hard to achieve in a compressed time frame. A few projects had only an individual student working on them, and those students often felt isolated from students working in teams on other foodscape nodes. Regularly scheduled cross-team meetings between concurrent projects, as well as a shared training program at the start of their involvement, would have supported those students more.

In hindsight, facilitated training in mentorship for staff and faculty participants and a formal process of tracking mentoring performance would also be helpful. We have since learned about the value of making mentorship agreements with students, and defining the respective responsibilities of mentors and mentees in these documents. The growing trend in some science faculty research groups toward articulating an explicit anti-racist laboratory policy and community guidelines (Berkeley Agroecology Lab, 2020; CLEAR Lab, 2021) can also offer examples of how mapping projects may develop their own policies. All this speaks to the importance of having sufficient funding to support a network of mentors to be able to dedicate substantial time to both working with students and developing their own competencies in mentorship.

Faculty Support, Institutional Home, and Funding

Only four other faculty members apart from Alastair participated consistently in the Foodcape Mapping Project subsequent to the initial 2015 equity and inclusion workshops that had inspired the map concept (11 faculty participated then). Increased faculty participation would widen the circle of mentorship for specific sub-projects (drawing on faculty-student interest convergence) and increase project legitimacy on campus. As consulting advisors, faculty can offer valuable expert research methods and content knowledge to inform student teams. We also counter-argue for the importance of legitimizing projects with shared, non-hierarchical leadership. The relative absence of faculty in our project probably helped create its collaborative, democratic culture. By contrast, over a dozen professional staff members were very active in data collection, student mentorship, and advocacy and their contributions created fewer power differentials with students. Staff used their program development skills to implement change in response to map findings. Overall, we feel that for campus foodscape mapping to thrive, more faculty involvement is needed, as long as this does not undermine non-hierarchical mapping practice or emphasis on JEDI. Faculty would need to sign on to the learning ontology we describe above, and be receptive to regular appraisals of whether they are acting to help cultivate a student-driven, collaborative learning environment.

If the project had its institutional home in a teaching department rather than a research center, more faculty might be involved and it could be better integrated into Berkeley's undergraduate Food Systems Minor and graduate Certificate in Food Systems, including as a series of consecutive classes.

¹⁶Basic needs security programming for students has been very robust on the Berkeley campus since 2014. The Foodscape Mapping Project identified low-wage staff, postdocs, and visiting scholars as additional communities facing high levels of food and housing insecurity. We worked to transform the Basic Need Center into a resource inclusive to these communities through several staff-specific programs.

Course structures such as Berkeley's American Cultures Engaged Scholarship Program (American Cultures Center, 2021) and sophomore seminars, for example, could also be conducive to a foodscape mapping project. The University of British Columbia Food Systems Project serves as an effective model of collaboration between teaching departments, research centers, and student service programs, with extensive coursework integration (Rojas et al., 2007). On the other hand, there were unique benefits to being outside the course structure, such as the potential for longer term engagement by some students, paid opportunities, smaller sized project teams, and not being constrained by course requirements. Moreover, with its mission to nourish interdisciplinary research and experiential learning across campus, the Berkeley Food Institute provided an unconventional home with a dedicated staff member that a discipline-based department may be less able to provide.

The project also had an unstable, small funding base that limited its full growth and created ongoing precarity. It relied on cobbling together small grants, held a crowdfunding campaign, and used a University of California systemwide fellowship program to fund paid student positions (see Funding, below). Taking advantage of the various institutional and educational resources available on a campus can help mapping progress. For instance, Alastair mobilized small grants (\$300–\$500 per student) associated with Berkeley's undergraduate research apprenticeship programs to help pay for technical development of the map's web platform, public workshops, and survey incentives. Yet, many projects and aspects of the Foodscape Mapping Project were unfunded, drawing instead on the voluntary labor of students and staff from across campus who were dedicated to the project goals. Graduate students also could not have their tuition fees covered because the project lacked large grants, thus making their participation depend on whether they could find other ways to pay the fees—a clear conflict for a project intended to increase JEDI in the campus foodscape. Rosalie also volunteered an average of 5 h per week beyond her paid staff position to support the project, which contributed to chronic burnout.

Alternative funding options would be to apply for larger internal or external grants, such as through a campus's research office or the U.S. Department of Agriculture, or to a foundation that supports food systems education, but these all pose significant costs and barriers to weigh. For example, applying to a foundation might mean that the project must meet reporting requirements and align with the donor's expressed priorities that might inhibit an expansive, flexible learning environment. Potentially, universities could be persuaded to make large, multi-year grants to enable their campus foodscapes to be mapped in the public service. The U.S. nationwide call for a so-called "racial reckoning" following the murder of George Floyd in 2020 speaks to a new heightened awareness and urgency for universities to take meaningful action on JEDI.

Critical Food Systems Pedagogy

Some of our most important lessons are to do with pedagogical design and practice. We should have taken on racial justice more explicitly by having each new project team begin with discussion of a set of core readings from critical race and decolonial

scholarship that are particularly relevant to university campuses, such as "Whiteness as Property" (Harris, 1993), excerpts from *Racism without Racists: Color-Blind Racism and the Persistence of Racial Inequality in America* (Bonilla-Silva, 2017), and the recently published "Land Grab Universities" (Lee and Ahtone, 2020). From there, readings could be added that are specific to each foodscape node. We (Rosalie and Alastair) could have consistently integrated discussion of our positionality as part of this dialogue, instead of treating this in an *ad hoc* manner. Each sub-project could have had more structured analysis of intersectional equity issues built into team dynamics and project management.

In our interviews students shared that they would have benefited greatly from readings and exercises related to hard research skills development (for example, designing surveys, conducting interviews, or reviewing historical documents). We paid for several students to participate in a workshop run by the Oral History Center at Berkeley, to aid them in collecting stories from underrepresented members of the campus about their food system and activism experiences. This skill-building could have been promoted more systematically, according to the needs of particular projects that students joined. This adds all the more to the mentoring responsibilities that project staff and faculty may face, which is why serious attention must be given to their training and support.

Finally, the project could have developed ways for students in separate sub-projects to learn from each other more consistently. Some fellows told us they only fully realized what the foodscape map looked like and what insights it offered as a whole during an April 2018 event at which student teams presented their work and we introduced the policy report of key findings. At different stages of the project, student teams were either focused on thinking about the foodscape as a whole (such as the early years and immediately after release of the report) whereas at other stages students deep dove into specific foodscape map nodes. These latter students worked on simultaneous semi-discrete projects. These in-depth projects were crucial to the "thick" materialization of the full campus system, but much further learning could have happened through making connections across sub-projects. Pedagogical ways to support this meta-learning include holding informal share out sessions between project teams at least twice per semester, more frequent public town halls, and assigning previous project work as essential readings for new teams.

CONCLUSION

Foodscape mapping is a powerful pedagogical and participatory research approach to food systems education that centers justice, equity, diversity, and inclusion. Mapping can help make a complex campus food system more legible and tractable by serving as a learning platform for students, staff, faculty, and administrators to collaborate on mutual learning and problem solving—that is, by providing a structure for inquiry-based, participatory, and action-focused knowledge production. We have attempted here to demonstrate how the UC Berkeley

Foodscape Mapping Project created an environment for expansive learning, where students became engaged actors in their education through achieving a level of sociocritical literacy. This learning-as-changemaking approach led to advocacy efforts aimed at improving the experiences of marginalized members of the campus community.

We have shared insights from our experiences at Berkeley to encourage other universities and colleges to consider embarking on their own mapping endeavors as part of developing their innovative food systems educational programs. Such mapping projects also need not be limited to the foodscape—the approach could be applied to, for example, climate equity or transportation equity. In closing, Alejandra Marquez offers these words on the power of mapping as a learning platform: “I think a lot of students, especially in Berkeley, we go to protest or we sign petitions and are part of campaigns or really want to change things at the university. Being part of the entire project and talking to the stakeholders really showed me what can be done beyond just organizing a campaign. More of an in-depth analysis of the need for change. What can happen if we change? Where can we go? What pathways are possible?”

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by UC Berkeley Committee for Protection of Human Subjects (CPHS). The participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

RF conceived of, wrote, edited this article, conducted, transcribed, coded the eight interviews with project fellows, served as project lead on conceptualization, methodology, investigation, supervision, mentorship of student researchers, analysis, data curation, visualization, project administration, and funding acquisition. AI conceived of, wrote, edited this article, coded the interviews, served as project champion, contributed to conceptualization, methodology, supervision, mentorship of student researchers, and funding acquisition. Both authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

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