Making space to care: A Community Garden for bioengineering labs

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Abstract

As qualitative researchers embedded in a biomedical engineering department, we are currently attempting to create a space for conversation and action among a self-selecting group of faculty. Framed as a Community Garden, this initiative is focused on supporting discussions and activities around "cultivating care" within labs in the department.

In this paper, we focus on outlining the empirical and theoretical context for this initiative. The Community Garden is part of a larger research project exploring the relationship between control and care in biological engineering. The laboratory is an important and complex site of negotiation between control and care: how do lab principal investigators (PIs) create environments that nurture the development of individual trainees at multiple career stages, while advancing their own career and research agenda in ways that will satisfy institutional expectations? This is fraught territory, grounded in an academic reward system that prioritizes individual performance. Persistent surveys of STEM trainees struggling with mental health [1], [2] highlight a culture of control linked to meritocratic systems that can prioritize PI career advancement over the well-being of lab members.

This culture is increasingly being challenged, by both trainees and mentors. How to support lab leaders invested in taking a different approach? How might we empower PIs looking to sustain a lab culture grounded more in care than control? We see this as a non-trivial challenge in light of the systemic forces outlined above. Care can take more work, time, responsiveness and emotional resource than control [3], [4]. The work of care is a gamble that could jeopardize the career progression of PIs in the short-term, but in the longer term might transform lab culture and practice – and perhaps the research that emerges.

Responding to colleagues who are actively working to foster more supportive and caring lab cultures, we are attempting to create a space for faculty in our department to work together to re-imagine their labs through a lens that prioritizes care alongside an appreciation for control. Rather than conceptualizing it as a traditional community of practice, we use the language of a "community garden" with the aim of tethering it to local sociopolitical context, emphasizing the active labor involved in enacting change (gardening is physical work), and fostering a shared, brave and experimental space for grappling with how to grow a different kind of lab.

Introduction

In this paper, we share the context and theoretical justification behind a Community Garden initiative we are spearheading within a biomedical engineering department at a large public university in the US. More of a metaphorical than an actual garden, this Community Garden is being framed as a space for "cultivating care" (rather than produce). With an initial focus on biomedical engineering faculty, this initiative is intended to build community and support the sharing of resources and practices among PIs (principal investigators) as they navigate the

complexities of running and maintaining a laboratory. Longer-term, it aspires to be a site for collectively re-imagining research and training in biomedical engineering within academia.

Our initial focus on engineering faculty and their labs is grounded in a growing body of research that identifies the laboratory as a central site of enculturation in STEM [5], [6], [7], [8]. For both undergraduate and graduate students, the lab serves not only as a technical training ground but also as a social environment shaped by an often complex mentoring structure involving faculty, research staff and fellow students [9]. These social dynamics play formative roles in students' development of self-efficacy, scientific identity, and scholarly aspirations [10], ultimately influencing how they come to understand academic work [11]. Individual labs can reinforce broader cultural patterns in engineering education—for example, often prioritizing technical expertise over social concerns [12], [13], [14]—and serve as key spaces where students learn what counts as legitimate knowledge and practice. Understanding how students cultivate attachment and belonging within lab settings [15], [16], [17] offers a window into the deeper pedagogical work that labs perform. In this paper, we start not from the perspective of the student but rather the PI. By exploring approaches to cultivating lab culture from the perspectives of faculty PIs, we hope to contribute to conversations regarding the importance of lab experiences in shaping students' technical growth and socialization into engineering cultures.

Background to the Community Garden

Figure 1. The Bioengineering, Society & Policy lab at ASU

Author 2 is a tenured professor in the field of science & technology studies (STS), with an unusual 50% appointment in the biomedical engineering (BME) department at Arizona State University.[1] She has been at the institution and held this joint appointment for 10 years, initially as an assistant professor. She is the lone qualitative researcher in the BME department. Like her engineering colleagues (and unlike most STS faculty), she has a "lab" space. Instead of lab benches, equipment and reagents, her lab is configured as a flexible meeting room, with moveable chairs and tables, a projector and screen, a large white board, and – importantly – a coffee machine and snacks. This space serves many purposes: project meetings with colleagues and student researchers, a classroom (when class sizes are small), a venue for hosting faculty writing groups, occasionally a space for doing yoga.

Having spent 10 years "alongside" BME colleagues [18], Author 2 has had many informal and long-running conversations about the ups and downs of running a lab. Over the years, some common features across PIs and career stages seem visible, but the details remain idiosyncratic, relating to individual personalities and specific social, political and material circumstances. Author

[1] The biomedical engineering program is housed within ASU's School of Biological & Health Systems Engineering (SBHSE).

2 has also observed a strong and active commitment among many of her colleagues to being "good" mentors, supporting students with varied backgrounds and interests on their individual journeys within STEM.

The daily ins-and-outs of running a lab aren't typically a focus of public conversation, they are the stuff of water cooler conversations. A "successful" PI, who is productive according to typical measures of academic success, is assumed to have figured out how to run their lab. Yet, labs are dynamic spaces – with people, reagents, data, ideas, money and more flowing through them – and PIs in practice must figure out how to harness this dynamism in ways that result in new knowledge and well-trained scientists/engineers, while maintaining at least a relatively consistent lab identity. This process can be full of surprises and challenges, and can require significant intellectual and emotional investment by the PI. Having peers and mentors with whom to share experiences and ideas can help to support the everyday but often invisible work of steering and maintaining a lab.

In January 2024, Author 1 joined Author 2's research group as a postdoctoral scholar, to work on a project exploring the relationship between care and control in bioengineering. With a background in adult education and theoretical interests in worldbuilding and feminist STS, she seized the opportunity to explore the relationship between theory and practice in this specific, situated context. Out of many lively conversations, a Community Garden initiative was seeded.
In Spring 2024, we invited any interested faculty in the department to participate in an interview, to share with us their experiences of running their lab and their overall approach to lab management. Six faculty volunteered (out of about 35). We used these conversations as a starting point for identifying common approaches, challenges, and potential topics for productive conversation. In Fall 2024, we issued an open invitation to the department, to participate in helping to shape a community of practice around cultivating care within BME labs. A self-selecting group of ~7 faculty have begun participating in monthly gatherings,[2] and are defining a collective agenda.

Figure 2. Small cosmetic updates to the lab that collectively begin to signal the space and intent of the Community Garden

To provide a physical home base for the Community Garden, we have started to make some small cosmetic changes to Author 2's lab space – bringing in plants,[3] creating a conversation corner, installing bookshelves, curating a small lending library, and posting quotations and a curated playlist up on a community noticeboard. We are in the process of developing and incorporating a variety of additional artifacts that invite visitors and community garden members to engage with ideas,

[2] This group overlaps with but is not identical to the group who participated in the interview stage.
[3] The challenge of identifying appropriate plants to survive in an institutional, climate-controlled building with indirect light from North-facing windows should not be underestimated.

themes and questions at the heart of the Community Garden. But the initial focus has been on creating an inviting and non-traditional space within an academic setting – intentionally different from the often white, sterile environment of a research lab [19], so as to set a different tone within an academic setting, and through this to begin to invite different ways of being / thinking / doing.

Logistically, we plan our monthly faculty gatherings with the following considerations: (1) identifying a regular time of the week (in our case, Friday afternoons) that tends to be a little more open for our group members, (2) being sensitive to the cadence of the academic year, and working around particularly busy periods and vacation times, (3) ensuring the availability of refreshments that appeal to the group and feel like a treat, (4) setting out small activities (coloring books, puzzles) for those who like to work with their hands, and (5) pre-circulating a draft agenda that offers entry points for the group's deliberations on a given day.

In what follows, we set the stage for the broad issues we are setting up the Community Garden to engage with. We draw on longstanding bodies of literature from STS, engineering education, and organizational leadership to paint a picture of the day-to-day work PIs do in running their labs, as well as the systemic forces they navigate, to better contextualize the types of questions we are choosing to focus on. And then we return to the question of why to set up a Community Garden initiative, why to label it as such, and what we hope to do.

The dual forces of care and control in (engineering) laboratories

Author 2 has a funded project underway exploring the relationship between care and control in bioengineering. While the primary research sites for this research are located outside her institution, she has also started to explore this relationship in the context of her own teaching and mentoring practices, and in academia more broadly. In this section, we make a case for interpreting laboratory research and mentoring practices through the dynamic of care and control, suggesting that it offers productive entry points for rethinking and recalibrating relationships in pursuit of alternative futures in academia.

Both care and control are both relational concepts – they draw entities together in relationship with each other. But these two words invoke different types of dispositions within the relationships, and different power dynamics and agency among the entities relating to one another. Control implies a more hierarchical, forceful, one-directional relationship, where one entity attempts to impose a particular view, set of values and/or behaviors or actions on others. It is typically instrumental, seeking set goals and focused on achieving specific outcomes or solutions. Stirling [20] argues that achieving control over society and nature is a central ethos of modernity – and of engineering specifically. While easy to slip into thinking that control is a negative impulse, it can also be explicitly tied up with commitments to responsibility and accountability for others and the planet. Granting others control to make certain kinds of decisions for us is a common feature in education and in society today, and is arguably necessary for getting certain things done in timely and effective ways.

Care implies a different, less hierarchical, more responsive and entangled approach to relationships than control. Drawing from feminist epistemology and growing interest on the topic of care within STS, care is often framed in terms of the work and practices needed to build, maintain and sustain

the world, with the goal of (human and non-human) thriving or flourishing [21], [22]. The outcomes are perhaps less instrumental than those sought through control. Care arguably requires more attachment to the subjects/objects of care than does control.[4] Importantly, the practice of care is not without its own power dynamics. There is often a paternalistic dimension to caregiving, where the caregiver may assume a position of power. Acts of care, even if aimed at supporting others, can be interpreted differently by those on the receiving end, and may reinforce systemic inequalities. Care is not a simple, benign, gentle practice – it is a deeply engaged interaction with the world that requires keen awareness of and responsiveness to power, privilege and systemic constraints. At its core, care calls for affective capacity to remain attuned to – and unsettled by – these complexities, in a way that control can have a tendency to gloss over.

The relationship between control and care in day-to-day lab work

We suggest that the laboratory is a site in which the relationship between control and care plays out in nuanced and meaningful ways.[5] Arguably both care and control are critical to "good" scientific practice. Highly controlled experiments allow for systematic and reliable knowledge about specific facets of the world to be obtained. Developing detailed protocols, robust infrastructure and clear expectations around safe lab practices are important for managing the flow of materials and data in the lab, in ways that allow efficient use of materials, reproducibility of findings, accountability to (often public) funders of the research underway, and safe working conditions for lab members.

Simultaneously, care is also a practice critical to good science. From caring for laboratory animals/organisms [23], to maintaining equipment and machines [24], "cleaning" and curating data [25], [26], and building scientific models [27], [28], careful practice underpins scientific knowledge production. Being a care-ful scientist is generally seen as a desirable trait.

Closer consideration of this characterization suggests a deep entanglement of both control and care in scientific practice. Careful scientists exhibit both control and care in their work. They are often painted as being rigorous, systematic, and vigilant in their data collection, curation and benchtop (or desktop) work, setting up consistent and controlled conditions for developing meaningful knowledge. But in order for the research to "work", a degree of tacit knowledge is usually also understood to be required – for example, having "green thumbs" when it comes to particular pieces of equipment or protocols, demonstrating "a feeling for the organism" [29], and knowing how to troubleshoot when things invariably go wrong [30]. These are affective skills that take time, labor and experience to build up, and reflect deep intellectual and often emotional attachments that scientists develop with their work.

While tacit skill and care in lab work is certainly recognized, in practice it is often gendered and devalued [31], [32]. Tending to animals and microorganisms in the lab, maintaining vital pieces of equipment, and sustaining collaborations across team members and research groups are all vital to the production of knowledge, but are all-too-easy to render invisible in pursuit of publishable data and findings. Indeed, the very notion that scientific facts stand independently of the people who

[4] Latour famously argues that the engineering myth of having total control over a technology allows a degree of emancipation or distancing from the outcomes of one's work (any undesirable consequences must have been unintended) [56].

[5] While the focus of our Community Garden initiative is with our local community of biomedical engineering colleagues, in what follows we focus on STEM labs and academia more broadly.

produce them is a framing that minimizes the role of the individual, situated researcher within scientific practice. The work of doing science has long been rendered secondary to the findings and outputs generated through this work.

In practice, the devaluing of care and maintenance work in laboratory life is in part related to broader systemic pressures. We turn to these now, continuing to explore the dynamic of control and care but expanding the scope beyond daily laboratory practice to think about the laboratory as a site within a bigger academic system. We focus specifically on the challenges that PIs face in running their labs in ways responsive to their situated contexts and the varied pressures they face.

Systemic pressures that shape lab management (and thus lab work)

The culture of academia has developed over time into a system that values and rewards productivity and individual excellence first and foremost. Competition for resources, metrics-driven evaluations (for scholarships, grants, tenure), and the push to continually grow one's academic enterprise accumulate create a highly meritocratic and pressurized system for researchers to navigate [6], [7], [33]. Success is largely attributed to individuals, which in turn self-selects for character traits including assertiveness, self- reliance and endurance [16], [33], [34]. The overall incentive structure is one that favors practices of control over practices of care in the pursuit of good science – valuing hierarchies, outputs and accumulation of capital (social and material), over the building of relationships and collaboration, and the distribution of intellectual and material wealth.

There is growing acknowledgement of this imbalance within the current system. We see in particular growing attention to what is sometimes being called a mental health crisis in STEM [1], [2], and has only become exacerbated during the COVID-19 pandemic [35]. Surveys have shown that unrealistic work expectations, combined with troubling patterns of discrimination and harassment, leave STEM researchers across career levels experiencing poor mental health. This is particularly the case for researchers from underrepresented groups, whose efforts to internalize the practices and ideals of the current system can come at great personal cost, and paradoxically reinforce their marginalization [15], [36], [37], [38], [39]. The current meritocratic and control-led system does not create baseline conditions for all researchers to grow and flourish in ways that align with their personal and professional values.

The challenge for PIs of balancing care and control

This is the fraught and challenging territory that PIs must navigate in running their research groups. And it is a situation that growing numbers of them are aware of and want to help improve. PIs in particular have critical roles in changing the system, in that laboratories are core sites of enculturation within STEM [5]. Trainees internalize disciplinary and cultural norms during their time in the lab, and then in turn may go on to propagate these practices in their future careers. Practices and expectations set by PIs can therefore live on long after a trainee leaves the lab.

However, PIs have particularly complex roles to navigate. They must manage fluctuating funding cycles, specific needs of trainees at different career stages, and the idiosyncrasies of the experimental configurations needed to pursue their line of research. As the main 'breadwinner' for their group [40], they are responsible for providing a secure financial base for their group members

to work from. They must lead in crafting an identity for their group grounded in specific and valued contributions to their disciplinary community, and coordinate and guide their research group to do and publish work that upholds this identity [6]. This involves finding ways to align individual research projects and career trajectories with the broader goals of the lab, supporting both individuals and the group as a whole. PIs often secure their initial position running a lab based on their technical and experimental acumen. But, once in position, their daily work typically becomes much more focused on managing people, communicating research externally, and securing funding [6], [41].

Throughout, PIs are themselves subject to the competitive and metrics-driven meritocratic system outlined above. Succeeding in this system is necessary for their individual careers – for example, to secure tenure and/or promotion – as well as to sustain their lab as a collective. The existing culture has undoubtedly influenced the training that many PIs received early in their careers, and sets norms for how to approach the challenge of advancing their group's research in a way that allows individual lab members to thrive.

Under such conditions, it can be convenient to retreat to top-down, command-and-control models of management. These can be more efficient, help to assert a strong group identity, and set clear expectations for individual productivity, benchmarks and career progression [40]. In practice, such approaches can preferentially reward homophilic students with particular character traits [16]. For some trainees, this can perpetuate the tension between conforming to a meritocratic system and developing their desired identities and agency within STEM.

Growing numbers of PIs both recognize and want to do something to break out of this pattern – even if doing so requires greater investment of time and emotional labor, and might come at some cost to their personal careers. Many are actively – sometimes quietly – working to experiment with and implement practices in their labs that are more attuned to the individual, situated needs and wishes of individual group members, that actively reward different metrics of success, incentivize bottom-up building of lab culture, and acknowledge the important work of cultivating relationships and networks of both professional and personal support.

One example we can turn to for leadership and inspiration is the CLEAR lab, run by Max Liboiron at Memorial University in Newfoundland.[6] As a feminist, anti-colonial laboratory that "foregounds values of humility, equity and good land relations," the CLEAR lab is explicitly and actively working to foster greater alignment among their research, personal and professional values. Through their innovations in running lab meetings,[7] author citation conventions in manuscripts [42], community engagement [43], and biowaste disposal [44], they offer examples of concrete changes to everyday practices that challenge and reinvent institutional habits solidified over generations, in ways better aligned with the values they collectively uphold as a lab.

Attending to care (and control) through a Community Garden

Having painted a sobering picture of the complex challenges that PIs navigate in running their labs, we start from a place of hope with the Community Garden initiative [45], [46]. Acknowledging the work that many of Author 2's colleagues in the BME department are already doing to attend to and

[6] The Civic Laboratory for Environmental Action Research, https://civiclaboratory.nl/.
[7] See https://civiclaboratory.nl/2017/03/31/how-to-run-a-feminist-science-lab-meeting/.

recalibrate the relationship between control and care within their labs, the Community Garden begins by acknowledging these experiences and strengths of the group, inviting sharing and capacity-building. In this, we assert an asset-based, rather than a deficit-based mode of academia [47], [48], [49], [50], [51]. This moves away from a view that problems within the lab are a direct result of deficiencies in either PI mentorship or lab trainee motivation, and encourages attention to structural, cultural and political dynamics that also shape academic practices. It also begins to redefine STEM leadership as a collective practice grounded in networks.

By adopting a care-based, participatory and action-oriented approach, we hope to empower laboratories as sites of micro-political engagement to catalyze systemic, transformative change. Such change is characteristically slow-paced, deeply affective, and inherently political. Moving forward, we are beginning to explore ways of inviting other members of the BME department (students, postdoctoral researchers, staff members) to convene in the Garden and participate in defining additional topics and matters of concern that they are motivated to pursue. One indication of the general interest in and support for this space was the unexpected creation of a new end-of-year departmental award for "Community Building," which was awarded to the Community Garden in April 2025.

Although metaphorical, our Community Garden label is intentional. While we could refer to this group as a "community of practice," the label of Community Garden invites stepping into a world outside of academia, and brings with it different affective and political valences. Community gardens are typically lively, often messy, places of growth and democratic engagement. They are ideally welcoming spaces for engaging in voluntary work deemed meaningful to a group. Importantly, they are tethered to local sociopolitical contexts, responding to identified community needs and drawing on local residents for energy, labor and expertise.[8] Community gardens challenge hierarchical managerial frameworks, providing settings where individuals can work on projects of collective value, and they cultivate relationships and identities rooted in care for community and local environments. They also draw attention to the variety of human and non-human relationships needed to sustain our world.[9]

We see supporting PIs to share and experiment with practices and lab-level activities as meaningful ways to begin imagining different systemic logics and visions of academic citizenship. In the current academic climate, creating spaces to support such imaginative capacities seems increasingly important. As Liboiron argues, we believe that community and solidarity are critical to supporting such efforts across different scales [52]. Our theory of change is grounded in slow activism [53], [54]—favoring intentional, relational, and affective change over the often fast, extractive logics of academia. This gradual process of challenging dominant

[8] We note that with the rapidly evolving landscape for academia since January 2025, the topics of our Community Garden sessions have pivoted somewhat to respond to current concerns and experiences of our group.

[9] In playing with this term, we were also struck by the parallels between laboratories and gardens – full of life, subject to climate fluctuations at scales small (e.g. rainstorms) and large (e.g. seasons). Both gardens and labs typically require environmental conditions that will support growth, and rely on some intentionality and tending to be productive, but not everything is under the gardener's control. "Green thumbs" are helpful for understanding what different parts of the garden/lab need, and when and how to best support them to thrive.

images is akin to what York [55] describes as “sidling up” when introducing STS in STEM spaces – a practice of allowing alternate images to coexist alongside dominant ones for a time, as a means of “centering what has traditionally been excluded or sidelined” (p.73).

Conditions of possibility for Community Garden efforts

Returning briefly to the origins of this initiative, we think it important to highlight the unusual institutional and material context underpinning this Community Garden, together with the long-term relationships that have led to its founding and make possible its continued existence in principle (if the community wishes it).

Establishing such an initiative within an engineering department is perhaps not an obvious or common undertaking. But it is not a particularly outlandish one at ASU, an institution that has intentionally experimented with fostering interdisciplinarity over the past 20 years. One increasingly common experiment at this university has been to create joint appointments (more formal than courtesy appointments) as ways of building bridges across departments. While accompanied by their own complexities—particularly when bridging across disciplines with quite different ways of knowing and being—joint appointments in can in principle institutionalize possibilities for long-term collegial relationships. Such relationships are grounded not just in voluntary affinities, but in shared commitments to defining and advancing departmental priorities.

This co-laboring may prove to be equally or indeed more important than having a physical space for Community Garden activities. Having control over a space certainly allows for more personalization and creativity in signaling the intent and active presence of a Community Garden, and may more readily invite an affective shift upon entering the space. But we suggest it would be possible to begin some of the work of the Community Garden without a dedicated space. Place-making is not reducible to physical affordances – our Community Garden also an intellectually and temporally defined space (and also includes some digital infrastructure), requiring investments in those dimensions also.

In our case, the establishment of a Community Garden has taken root thanks to the availability of physical space, the long-term presence of Author 2 in the BME department, and through this presence, the development of trust, collegiality and the identification of shared concerns that do not fall neatly into existing committee or mentoring structures. It is this idiosyncratic intersection that we strive to inhabit through our initiative. For others contemplating the possibilities for related efforts, we encourage engaging seriously with the specific material, institutional and interpersonal conditions at the local level (e.g. department, institute, cohort, or other meaningful grouping), and working creatively to build on existing assets in ways that invite context-specific, bottom-up cultural change.

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