



**Global**    

**Insights**   

**into**     

**Transdisciplinary**

**Higher**    

**Education**  

**Initiatives**  



Edited by Todd E. Nicewonger and Catherine T. Amelink

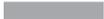
Interest in transdisciplinary learning has continued to expand across higher education, building on previous efforts and creating spaces for new learning experiments. Institutional stakeholders tasked with leading these initiatives have developed important insights and management practices, which the chapters in this volume highlight. The case studies gathered in this volume provide a behind-the-scenes look at lessons learned, shedding light on the past and future of transdisciplinary learning in higher education.

Global Insights into  
Transdisciplinary Higher Education Initiatives



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*TODD E. NICEWONGER  
AND CATHERINE T. AMELINK*

  
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# Introduction

TODD E. NICEWONGER AND CATHERINE T. AMELINK

This edited volume is an account of a remarkable, recent global reimagining of university systems, intended to respond to the defining upheavals of the contemporary. This institutional revolution argued for undoing scholastic boundaries and creating radically open spaces for intellectual debate, exchange, and pedagogy (e.g., Crow & Dabars, 2015; McGregor, 2017; European Commission, 2020). Guided by this doctrine of “transdisciplinarity,” this movement aimed to reverse an approximately hundred-year-old trend, in which universities became increasingly oriented around growing numbers of specialized disciplines and departments (Osborne, 2015; Rikakis et al., 2018). In the process, university leaders evoked concepts like “Big Sticky Problems,” “Moonshots,” and “Grand Challenges” to create shared discourses for describing the ethos of these initiatives. These concepts also aided university leaders in tying their individual campus initiatives to calls from thought leaders about the need to reimagine the scope and intent of university systems so that they are better positioned to address complex, emergent societal problems (e.g., Popowitz & Dorgelo 2018). In response, university officials launched steering committees and public relations campaigns, along with specially designed funding schemes and activities for fostering cross-disciplinary collaborations and new curricular projects so that graduates would more readily receive skills and knowledge needed to address complex societal challenges. Yet, what did these initiatives actually achieve? What kinds of socio-political debates, external considerations, and assumptions about transdisciplinary knowledge production inspired these movements and the educational activities they engendered? How is the definition of transdisciplinarity influenced by institutional and socio-cultural contexts? Moreover, what lessons can be learned from critically reflecting on the experiences of faculty and administrative staff involved in initiatives to create new curricular offerings, and how can such analyses contribute to the future of transdisciplinary learning in higher education?

As editors, the motivation for exploring these questions came from our experiences leading and supporting a campus-wide transdisciplinary learning and research initiative at Virginia Tech. As we worked to implement the

university vision for this initiative, we were confronted with numerous challenges that touched on multiple issues, including faculty support, student interest, budgetary constraints, curricular governance, and misalignments with promotion and tenure practices. In talking with colleagues at other institutions in the US and internationally, we found that many of them were struggling with similar issues, and we began to realize there was an opportunity to learn from one another. Consequently, this volume is built on the idea that much can be gained from sharing lived experiences associated with the development, implementation, and sustaining of transdisciplinary learning programs, including how they emerged, the way they are organized, and the experiences that staff and faculty face in continuing to provide relevant and meaningful transdisciplinary educational opportunities.

Following is a collection of institution- and program-specific transdisciplinary efforts that have been chosen for the opportunity they provide to reflect on these issues and explore the deeper context behind the movement toward the development of transdisciplinary learning models and initiatives. The exemplars shared in this volume provide insight into the impact that these efforts have had on people, politics, and concepts of educational leadership. This includes contributions from scholars and practitioners working on transdisciplinary learning initiatives in Australia, Switzerland, the European Union, and in five different locations throughout the United States. The case studies and related reflections developed by this cross-continental cast of contributors include descriptions of how different institutions have approached transdisciplinary curricular development, including the organizational principles, successes, and challenges that have shaped the authors' experiences managing and/or teaching in these programs. This volume also includes descriptions of different curricular models, ranging from integrated learning certificate programs to stand-alone transdisciplinary courses that are part of wider campus initiatives promoting cross-disciplinary learning. It also includes curricular examples that are situated in applied research and learning programs and from the perspective of a member of a curricular design committee who was tasked with creating a transdisciplinary master's degree program involving multiple universities in the European Union. Additionally, several chapters reflect on how the meaning of transdisciplinarity is shaped by institutional commitments, the topic or theme that a particular transdisciplinary learning effort is focused on, and the socio-cultural factors in which the institution is situated.

Chapter contributors highlight promising practices for creating, imple-

menting, and sustaining transdisciplinary learning initiatives in higher education. For example, across the chapters, it becomes evident that engagements with transdisciplinary learning programs can positively impact student experiences, faculty careers, and communities that are engaged in these efforts. This includes reflections in several chapters on how management practices used by faculty and staff can inform both existing and emerging initiatives by helping to define the contribution that transdisciplinary learning opportunities can have on student development. At the same time, the collection of programs encompassed in this volume offer up a challenge to thought leaders. This challenge is inclusive of university leadership, faculty, students, and community stakeholders because it concerns the influence that learning environments have in creating opportunities for transdisciplinary learning programs, which we have synthesized as follows and readers can reflect on as they engage in their own transdisciplinary learning projects.

- What is the origin point(s) for transdisciplinary learning efforts at your institution, and in what ways does this origin point impact the formulation and trajectory of the initiative?
- In what ways can the impact of transdisciplinary learning initiatives at your institution be measured? How can the impact of these initiatives on faculty, students, community partners, and the institution be adequately captured? How can the measuring of this impact be used to influence the restructuring of institutional management systems that support or serve as barriers to transdisciplinary learning?
- What factors serve as a “green light” for the sustainability of transdisciplinary learning opportunities? How are these factors navigated by leaders, supporters, and participants of transdisciplinary learning at your institution?
- Is there a common language that is being used to describe transdisciplinary learning efforts at your institution that needs definition? Does the definition differ by role, learning context, socio-cultural factors, and disciplinary values?

# Chapter Summaries

In **Chapter 1**, readers are introduced to the Bridging Disciplines Programs (BDPs) at the University of Texas at Austin in the United States. In this chapter, the authors trace the initial inspiration for the development of this program back to the late 1990s when a national report called for changes to undergraduate education, including the expansion of integrated learning opportunities on US campuses. Responding to this call, the chapter's authors describe how university leaders formed a committee to explore the report's implications, which eventually led to the development of the BDPs transdisciplinary certificate programs for undergraduates in the early 2000s. Two decades later, the BDPs continue to thrive, even as the university campus has experienced multiple administrative, funding, and educational changes over the years. This includes transitioning from being a unique, stand-alone academic program to one that now sits alongside multiple transdisciplinary learning and research initiatives. But as the authors also make clear, the university's increased investment in transdisciplinary learning and research has occurred while institutional boundaries continued to dominate the organizational culture of the university. As a result, the BDPs' staff and faculty have had to adapt to a constantly changing institutional landscape that is not readily designed to promote cross-disciplinary sharing of resources or make it easy for students to take classes outside of their major. In describing these issues, this chapter raises questions about pilot programming, the importance of taking time to build relationships with colleagues in other programs, and institutional pathways and barriers.

In **Chapter 2**, readers are invited to explore how a transdisciplinary scholar pursued and was selected to contribute to the co-development of a graduate level transdisciplinary program that would be offered through a European collaboration in higher education. In reflecting on this experience, the author introduces "Knowledge Creating Teams" as a structure for approaching the development of transdisciplinary curriculum on university campuses across Europe. This includes reflecting on the importance, positioning, and impact of leadership roles, including how faculty find intrinsic motivation to voluntarily participate in the design of transformative educational opportunities. Questions are also raised about the cultural assignment of educational values, including whether flexibility and nimbleness are important considerations in the design of transdisciplinary curriculum, and what role eco-

conomic and political motivation should play in the design of transdisciplinary learning efforts. Importantly, this chapter highlights unique challenges and considerations in the graduate education space across the continuum of the department to the scale of international collaboration, while also providing insight on how transdisciplinary learning in European higher education is being shaped by EU policies and practices.

Bass Connections is the name of the American cross-disciplinary program explored in **Chapter 3**. The authors of this chapter explore the role and importance of community partners, student access to integrated learning opportunities, and how evaluation methodologies for integrated learning can be used to further scale programmatic efforts. Unlike other chapters in this volume, this program is supported by a generous endowment, which the university has used to create an applied research program that is open to both undergraduate and graduate students. The funding for this program allows project managers to receive a stipend, as well as provide funding for resources that support research activities. Subsequently, students in Bass Connections work with faculty mentors on real-world problems that draw on cross-disciplinary approaches, which often exceed their disciplinary training. Through this experience, students gain a deeper understanding of interdisciplinary team dynamics and develop skills for addressing complex problems through interdisciplinary knowledge practices. Moreover, in reflecting on the organizational history and structure of this program, this chapter raises questions about the importance of exploring the origin point for transdisciplinary learning initiatives, such as the role that the university's desire to engage with the outside community played in the curricular design of the program. Furthermore, background information on how this effort centers around problem-based learning provides an additional and important layer of insight.

On the campus of Rapperswil-Jona in Switzerland, a transdisciplinary curriculum has literally taken root in the soils of the university's grounds. The authors of **Chapter 4** describe "living labs" as a transdisciplinary teaching, research, and public outreach program that centers on sustainability concerns. Integral to the program's curriculum is the use of planting schemes to teach about biodiversity and sustainability. It also includes opportunities to learn about local sustainability issues, as well as how fauna, insect, and plant life on the university campus are connected to wider regional and global concerns. Furthermore, readers will gain additional insights into how the program teaches students to apply integrated concepts and methods

for working across multiple scales of sustainability. In doing so, this chapter offers a rich example of how transdisciplinary curriculums can engender new ways of learning and expanding knowledge about the greening of public spaces, while also providing a space for experimentation and inquiry that is designed to inspire new sustainable theories and actions, both now and in the future.

Issues of sustainability are also at the heart of **Chapter 5**, which traces its origins back to the 2010s when President Obama called on university leaders in the United States to address “21<sup>st</sup> Century Grand Challenges.” In response, higher education leaders throughout the US initiated new transdisciplinary initiatives or renewed their commitment to existing programs (cf. Popowitz & Dorgelo, 2018). This included the University of California, Los Angeles, which is situated in one of the densest urban regions in the United States. The immense water, waste, and related service needs of residents in this region are extremely demanding, and because of this, community leaders have long been concerned about the city’s future sustainability. Like other large universities discussed in this volume, local issues are framed in relation to wider planetary concerns that students engage with through undergraduate research opportunities. These opportunities have, in turn, helped foster collaborations among faculty and students from different departments and colleges, while also contributing to transforming Los Angeles into a more sustainable metropolis. Additionally, the involvement of industry and community partners in this program provides students with opportunities to learn about the methods and approaches that are being used by organizations and experts outside the academy who are working to address twenty-first century challenges.

In **Chapter 6**, the authors reflect on their personal and professional experiences managing a cross-disciplinary critical theory, social science, media, art, and design certificate program at a large research one (R1) university in the American Midwest. Both authors are full-time faculty members who first developed the curriculum for this program at the start of their careers. Over a decade later, they continue to manage this program, which provides integrated learning opportunities to students who are looking to explore societal issues using creative methodologies. But sustaining this program has been challenging. This includes having to continually deal with institutional changes in leadership and funding while also juggling shifting departmental responsibilities and changing professional lives. In response, the authors have had to be resourceful and adaptive. But working in this way has also

led them to pause and reflect on lingering concerns about how their contributions and commitment to this program are valued. In doing so, the authors provide a personalized analysis of their experiences that touches on several hard-pressing issues that are likely to resonate with other practitioners leading transdisciplinary efforts. In unpacking these issues, this chapter shifts the focus on transdisciplinary learning from the motivation of designing opportunities to considering the long-term viability of a program. Threaded through these reflections is a thought-provoking exploration of how care and value-making are linked to the repair and maintenance of transdisciplinary learning efforts.

The transformative experiences of co-teaching a transdisciplinary course at an Australian university are explored in **Chapter 7**. Like in the following chapter (Chapter 8), the authors begin with a rich description of the history and current organizational structure of a campus-wide transdisciplinary learning program. This curriculum has grown and developed over its tenure and so too has its teaching staff, who in this chapter reflect on what it means to teach a transdisciplinary course using an integrative method with other scholars who bring different disciplinary perspectives to bear on course topics. This includes drawing on a reflexive method called the “reflection circle,” which they use to identify and analyze “key moments” that impacted their own understanding of the teaching and learning process and allowed them to develop a collective conviction of purpose. Another important topic explored in this chapter is the transformation of the instructors and designers of these transdisciplinary learning opportunities. As faculty are exposed to new ways of talking about curriculum, they need to also have the time, space, and support to allow for the creation of shared concepts and practices. Together, reflecting on such experiences can reveal how power relationships enter pedagogical spaces, while also foregrounding the importance of “mutual learning” as both a collective and personal aspect of being part of a teaching team.

**Chapter 8** draws on the experiences of a mixed team of specialists who collectively taught a concurrent transdisciplinary undergraduate class at a Mid-Atlantic university in the United States. Central to their experience was the principle of trust-building, which they explain simultaneously influenced their pedagogical approach to teaching this course and affected their interpersonal understanding of what it means to teach from an integrated perspective. To help illustrate this point, a significant portion of the chapter is dedicated to distinguishing between various teaching team models. The

chapter then describes how this team collectively approached trust-building, which they argue necessitates serious commitment and continuous practice to successfully implement. Moreover, this course became increasingly integrative through the team's continuous efforts at trust-building, both in and outside of the classroom. In reflecting on these experiences, this chapter makes an important contribution to an understudied area of transdisciplinary scholarship in higher education. The chapter also illustrates the significant amount of time and energy that goes into team teaching transdisciplinary courses, which the authors argue needs to be more fully acknowledged and valued within the university system.

In closing, as editors of this volume, we hope that readers will find multiple purposes for the examples presented here and that this work can inform their immediate and future endeavors. While we were working on this volume, we continued to lead and support our own institution's transdisciplinary learning efforts. As a result, we are aware of the ongoing and emerging educational opportunities connected to transdisciplinarity. The acute and increasing proliferation of complex societal challenges requires the sharing of promising transdisciplinary programming practices so higher education can continue to prepare future leaders positioned to address the most pressing issues of our time. Finally, we would like to thank the anonymous external evaluators for their careful reading and feedback on all the chapters.

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# I. Bridging Disciplines in Undergraduate Education

## *Overcoming Barriers to Transdisciplinary Learning at a Public Research University*

JEANETTE HERMAN AND PAULINE TURNER STRONG

Whether they fall under the rubric of interdisciplinarity or transdisciplinarity, educational programs and initiatives with integrative approaches are today celebrated at colleges and universities around the world. These integrative approaches to curriculum design and pedagogy are so ubiquitous and form such a featured part of universities' messaging about what they offer to students and faculty that it can be easy to forget that these approaches have only taken hold in higher education relatively recently. In lauding the successes of interdisciplinary and transdisciplinary programs, it can be easy to gloss over the challenges these programs have faced and continue to face in offering an integrative educational experience within the context of a university structure that remains largely rooted in traditional academic disciplines.

In this chapter, we tell the story of the Bridging Disciplines Programs (BDPs) at the University of Texas at Austin, a major public research university that serves about fifty-two thousand students across nineteen colleges and schools. Now an established set of seventeen college-bridging certificate programs that serve about eight hundred undergraduates at any given time, the BDPs felt conceptually innovative and even a little subversive to the faculty members comprising the Connexus Vision Committee, which conceived of them back in 2002. Connexus: Connections in Undergraduate Studies was part of the portfolio of Lucia Albino Gilbert, then the Vice Provost for Undergraduate Studies; Connexus also established several other programs intended to integrate and enhance the undergraduate learning experience, including EUREKA, an undergraduate research dashboard; Maymester Abroad; and one-hour interdisciplinary Forum Seminars (Gilbert et al., 2005, Schilt & Gilbert 2008).

Drawing on our experience with the BDPs, their students, and their faculty

for more than two decades, we discuss the history of this program, its model for providing an interdisciplinary and transdisciplinary educational experience for undergraduates, and how it has addressed institutional obstacles to providing this experience. We also draw on surveys of students, alumni, and faculty to discuss the program's successes and continuing challenges, looking at the impact of the BDPs through the lenses of student and alumni learning, faculty participation, and the ways in which the landscape for interdisciplinary and transdisciplinary educational opportunities at UT-Austin has and has not changed since the BDPs were launched.

We tell this story from two different but intersecting perspectives. Jeanette Herman, an assistant vice provost in the Undergraduate College, has directed the BDPs since 2006. She has worked with faculty from across the university to develop nine BDP certificates, collaborated with faculty and administrators in developing college-bridging degrees and majors, and taught interdisciplinary courses in human rights and women's and gender studies. This chapter draws on her extensive experience with BDP curricula, students, alumni, and faculty, as well as practical experience navigating the challenges of creating and offering interdisciplinary and transdisciplinary educational programs. Pauline Turner Strong, a professor of anthropology, gender studies, and human dimensions of organizations, has been involved with the BDPs since their conception. She served on the Connexus Vision Committee and continues to serve on the BDP Steering Committee. She helped design the BDPs in Museum Studies and Patients, Practitioners, and Cultures of Care, and she serves on the faculty panels for these BDPs. She teaches the introductory course for the BDP in Museum Studies, lectures in the introductory course in Patients, Practitioners, and Cultures of Care, and advises BDP students on their connecting experiences (internships and independent research). While Herman has extensive experience in program development and administration, Strong has experience in many of the roles that faculty have played in program development, student recruitment, teaching, and mentoring.

# A Vision for Interdisciplinary, Integrative Undergraduate Education

The BDPs were designed in the wake of the 1998 Boyer Report, which offered a model for reinventing undergraduate education at major research universities. The report contained ten major recommendations, including making research-based learning the standard (item 1); constructing an inquiry-based freshman year (item 2); building systematically on the freshman foundation (item 3); removing barriers to interdisciplinary education (item 4); and requiring a culminating capstone experience (item 7; Boyer Commission, 1998, Abstract). Dedicated to the memory of Ernest L. Boyer—President of the Carnegie Foundation for the Advancement of Teaching, former Chancellor of the State University of New York, former US Commissioner of Education, and the original Chair of the Commission—the report was funded by the Carnegie Foundation. It represented the work of Shirley Strum Kenny (Chair), Wayne C. Booth, Kathleen Hall Jamieson, Robert M. O’Neil, Chen Ning Yang, and other prominent humanists, scientists, social scientists, educators, and communicators. Appearing in the context of widespread questioning of undergraduate education in the United States, the report highlighted the slowness of research universities to implement change in the undergraduate curriculum (Katkin, 2003, pp. 19–21). A 2001 survey of 123 research universities that offer baccalaureate degrees (Boyer Commission, 2001) found that reform efforts had largely focused on the Commission’s first three recommendations: engaging undergraduates in research; constructing a first-year experience emphasizing active learning and the development of critical skills; and building on the first-year experience through inquiry-based learning, collaborative experiences, and the development of communication skills (Katkin, 2003, p. 23).

In contrast, perhaps, to the more typical response to the Boyer Report, the Connexus Vision Committee at UT-Austin was charged by then-Provost Sheldon Ekland-Olson with finding a way to remove barriers to interdisciplinary education (recommendation 4). The committee, comprised of senior, award-winning faculty, focused on creating a structure for curricular collaboration across departments and colleges, with the goal of helping students navigate the university and make their electives cohere. The Vision Committee was asked to create nimble programs that could respond to fac-

ulty interests and student demands without requiring the establishment of new departments or degrees. The committee was also charged with creating programs that would serve all undergraduates, not primarily honors students (who were already well-served by existing programs). Finally, the Vision Committee sought to create a way of scaffolding courses, building toward opportunities for independent inquiry (recommendations 1 and 7). In all these activities, the Vision Committee worked on a conceptual level, relying on the crucial assistance of professional staff and academic advisors for implementation.

## Curricular Design for Integrative Learning

As a model for integrative education at a research university, the BDPs combine multidisciplinary, interdisciplinary, and transdisciplinary learning through a flexible structure designed to complement and enrich students' learning within their majors. Some definitions are helpful here. Integrative approaches to education foreground the crossing of disciplinary boundaries and problem- or theme-based learning, and they restructure education in ways that “acknowledge and respect epistemological pluralism” to work toward more integrative understandings of complex problems (Fam et al., 2018). Under this umbrella fall various approaches, including interdisciplinary and transdisciplinary pedagogies and curriculum. Sue McGregor (2017) concisely describes the differences and connections among these forms of integrative education:

If higher education students are fortunate, they will experience more than disciplinary learning and be exposed to multidisciplinary learning (more than one discipline, with no integration), and interdisciplinary learning (between disciplines, with integration). All these approaches remain confined to disciplines, excluding other ways of knowing. Transdisciplinarity pushes the boundaries of these three approaches to include both higher education (mono, multi and interdisciplinary) and larger society (government, industry, citizens and civil society). [Transdisciplinary] pedagogy helps students to learn to co-create, co-disseminate, and co-use transdisciplinary knowledge,

which emerges from the iterative interactions between disciplines and the rest of the world. (p. 3)

Whereas interdisciplinary approaches engage students in bringing together methods, tools, and concepts from multiple disciplines to create new knowledge or understanding, transdisciplinary approaches seek to transcend disciplines, often through problem-focused research with an evolving, collaborative, community-centered methodology (Klein, 2018; Gibbs et al., 2018).

The design of BDP certificates is integrative, with elements in each program that engage students in both interdisciplinary and transdisciplinary learning. Each BDP certificate consists of 18–20 credit hours that include the following required elements, with flexibility within the overarching structure for faculty designing the curricula and for students choosing courses and experiences that address their interests and goals. These comprise:

- *Foundational courses*: These courses provide grounding in the BDP topic. Some may be located within a specific discipline, but every BDP certificate includes at least one course that engages students in learning to apply interdisciplinary and/or transdisciplinary approaches to the BDP topic.
- *Strand courses*: These are more specialized courses, drawn from the rich variety of existing courses in the UT curriculum, that allow students to focus on their specific interests or goals. Students' selections for strand and foundational courses may intersect with major, general education, and elective courses, and they must collectively represent a range of disciplinary approaches to the topic.
- *Connecting experiences*: These are undergraduate research, internship, or creative or capstone projects that give students hands-on experience relevant to their BDP topic. These experiences connect students' majors with their BDP topics, connect coursework with preparation for careers, and frequently involve collaboration with other students, research teams, professionals, or community members.
- *Reflective writing*: Each student engages in multiple forms of reflective writing, beginning with an application essay in which they articulate learning goals, and culminating with an integration essay in which they reflect on their learning throughout the BDP.

The coursework elements of a BDP curriculum are primarily designed to engage students in multi- and interdisciplinary learning, as they engage students in studying their BDP topic from multiple disciplinary perspectives, with integration in their interdisciplinary foundation courses and in reflective writing that asks them to put these perspectives in conversation with one another. The connecting experiences, by contrast, engage students in more transdisciplinary learning—putting their coursework into practice and conversation with the world outside the university through research that addresses real-world issues and problems and through work within non-profit, for-profit, and governmental organizations. For many students, their connecting experiences also involve collaboration, whether within internship sites, with research teams, or with student teams working on creative or design projects.

If multi-, inter-, and transdisciplinary approaches are understood as designations that progressively move toward greater degrees of knowledge integration (Remington-Doucette et al., 2013), BDP certificates lead students through this progression by helping them learn in more integrative ways as they move through their curriculum. Importantly, BDP certificates are designed to provide an integrative educational experience at the curricular level, not primarily at the course level. The certificates provide students with an alternative and complementary way of planning and reflecting on their educational trajectory, serving as an organizing structure that gives students a new way of making meaning from their curricular and co-curricular work throughout their time at UT-Austin. Central to the design of the program are academic advising and faculty mentorship, which support students in planning their certificate elements as intentional parts of their educational and career journeys and in reflecting on the connections among these elements, so that students emerge from the program with a level of understanding that transcends the collection of discrete courses that make up the certificate requirements.

As an example of how the program progressively leads students toward greater levels of integration, we can follow a student in the Museum Studies BDP. A Russian, East European, and Eurasian Studies major who applied to the Museum Studies program in her sophomore year took two interdisciplinary BDP foundation courses on museum studies, one of them team-taught by faculty from Art History and Geosciences. Her strand courses included a course on historical museums from the School of Information; a communication studies course on visual media and interaction; and a rhetoric course

on visual rhetoric. This student pursued two connecting experiences: an internship at a sculpture garden, where she worked with a team on creating a video about an exhibition, and an independent research project focusing on how curatorial methods affect the representation of Latin American cultures in museums. Though the specific course and connecting experience choices are unique to each student, this trajectory is typical for Museum Studies students. A Museum Studies student responding to an exit survey administered to graduating students, when asked to describe what they liked best about participating in the BDP, responded:

I enjoyed the interdisciplinary features of the program not only in courses but in the purpose of Connecting Experiences and as topics of the required essays, which made you think about them more thoroughly. It also helped me realize just how interdisciplinary the museum field is, what direction and motivations different departments are coming from, and why outcomes occur in certain ways.

This reflection nicely encapsulates how the different elements of the program—courses, connecting experiences, and reflective writing—work together to support integrative learning about the BDP topic.

## The Challenges of Transdisciplinary Education Within a Disciplinary Organization

Offering an interdisciplinary and transdisciplinary program within a disciplinary institutional context has not been without challenges. Indeed, part of the success of the BDPs can be attributed to a program design that recognizes and works within the limitations of this institutional context, allowing it to navigate challenges related to resources, conceptual disagreements that arise from working across disciplines, and the accessibility of courses and experiences for students pursuing a range of degree programs.

**Budgetary Challenges.** UT-Austin is a large, public research university that has seen a steady decline in state funding over the past four decades; in 2020–2021, state general revenue accounted for only 10 percent of UT's budget, down from 22 percent in 2000–2001, shortly before the BDPs were created. Deans of the university's colleges and schools control most of the

budget for the academic core, and they are responsible for ensuring that students in their degree plans can graduate on time. In this context of declining resources combined with a college-based organizational structure, funding for interdisciplinary programs—and particularly for cross-college programs—can be insecure.

The BDPs have survived and thrived over this period because they were designed to function in a lean way, taking advantage of existing strengths in faculty expertise and curriculum across the university. The program has no faculty lines, relying instead on faculty with homes in the various colleges and schools to serve on committees that govern the BDP certificates and to mentor students in connecting experiences. Less than 2 percent of the more than twenty-five hundred course listings across the BDP certificates are courses developed specifically for the program, with most courses drawn from regular offerings in departments across campus. As a result, the program can operate with a relatively small budget, consisting mostly of staff salaries for academic advisors and administrative support, along with a small instructional budget for the interdisciplinary foundational courses offered specifically for each BDP certificate. The central institutional location of the BDPs—first housed in the Provost's Office, and then, since 2006, in the newly formed School of Undergraduate Studies (now renamed the Undergraduate College)—is another reason the program has weathered multiple rounds of budget cuts. Being housed in a unit whose purpose is in part to champion the parts of the curriculum that do not reside within individual majors has meant that the BDPs have been prioritized as central to the unit's mission. At the same time, the flexibility gained by offering certificates rather than majors, and by coordinating with faculty whose homes are in departments across campus rather than hiring our own faculty, has allowed the BDPs to be responsive to changing student needs, both in adding new programs relatively quickly and in phasing out programs that are no longer in demand.

**Conceptual and Epistemological Challenges.** Another set of challenges the BDPs have had to address is curricular. Each time we develop a new BDP certificate, responding to student needs and/or faculty interest, part of the curriculum development process involves discovering and working through disciplinary fault lines. Often these tensions come to the fore in discussions about which courses do and do not fit within the program, or what kinds of courses are foundational. For example, the Patients, Practitioners, and Cultures of Care BDP brings the humanities together with interprofessional clinical perspectives to explore health and health care. Even though

the program aims to bring together humanities and clinical approaches, tensions between faculty coming from a humanities background and those with a clinical background were apparent in the curriculum development process, as were tensions among the various clinical perspectives represented (medicine, nursing, pharmacy, and social work). Early debates about the title of the program were revealing, as faculty debated whether the word “Practitioners” should be replaced by the word “Healers.” Some faculty from both clinical and humanities backgrounds preferred the term “Healers,” appreciating its focus on relationships and finding it warmer and more evocative of resiliency in care providers than “Practitioners.” Other faculty, again coming from both the clinical and the humanities sides, raised concerns that from some cultural or disciplinary perspectives, “Healer” might have unintended negative resonances, either evoking “new age” practices and the exclusion of clinical approaches or taking agency away from patients and their role in the healing process. Negotiating such tensions requires a willingness to have uncomfortable conversations, to examine disciplinary and other assumptions underlying them, and to compromise in order to allow space for multiple perspectives to shape the curriculum.

Similar tensions arise in all the BDP panels, especially when faculty discuss whether a particular course should count toward the BDP (Is it multidisciplinary enough? Does it focus on the BDP topic enough?). The work of developing and governing cross-disciplinary programs requires a tolerance for discomfort as tensions arise, as well as facilitation that emphasizes respect for diverse perspectives and communication across different vocabularies—values that mirror those we hope students will develop through their certificates. Bringing a student lens to conversations is often an effective tool in these conversations. While curricular conversations that stay at the conceptual level can feel abstract and theoretical, student voices and examples of how students move through the BDP curricula help to ground these conversations in the wide variety of student goals and experiences that shape actual learning experiences. For example, in developing a new BDP certificate focusing on the criminal legal system, a disagreement related to the program name was resolved in part through a student focus group, which allowed faculty to understand how students were engaging with the terms they were debating.

**Accessibility and Advising Challenges.** From a student perspective, gaining access to classes outside of one’s major can be challenging on a campus with over forty thousand undergraduates. Most of the accessible non-major

courses tend to be introductory, often discipline-focused survey courses that may not fit with the BDP themes. Restrictions that limit courses to students in that major and nested prerequisites are common, and competition for available seats set aside for non-majors makes it difficult for students to be able to count on access to courses they need. Moreover, with so many course offerings, students may not be aware of courses relevant to their interests. As a result, it has been important for the program to advise students on which courses are available for their BDP each semester and to facilitate student requests for seats in certificate courses outside their majors. By developing relationships with departments across campus, we have been able to gain access for students to many courses that would otherwise be restricted to majors, and in some cases, we have been able to arrange for prerequisites to be waived. For example, in the Digital Arts and Media certificate, we have close collaborations with relevant departments in the Colleges of Fine Arts and Communication, allowing students access to courses in animation, game design, or immersive media that would otherwise be closed to them.

Even when students have access to courses outside their majors, tightly prescribed degree plans can make it difficult for students to pursue these courses without extending their time to degree (a concern within the university throughout most of the BDPs' existence). Although some majors provide flexibility with multiple electives, many degrees provide little choice and build in few electives. An important element of the design of the BDPs is that they allow for "double-dipping," or counting courses toward the BDP certificate that may also count for other degree requirements, whether in the core curriculum, college-level requirements, a limited number of major courses, or electives. This flexibility allows students to make decisions about how to progress through their degree requirements with the BDP theme in mind, bringing an integrative lens to requirements that otherwise would be discrete and unrelated. A history major who completed an Environment and Sustainability BDP certificate, for example, was able to count toward their certificate requirements a course on global environmental history that also satisfied a general education writing requirement; a course on European environmental politics that counted toward their major; and a geology course on sustainability and a geography course on environmental science that both satisfied core curriculum requirements. In response to an open-ended question in the BDP exit survey asking students to describe what they liked best about participating, 41 percent of the 294 respondents mentioned

the ability to take classes outside their major or the variety of courses they took for the certificate—the most common theme across these responses. The ability for students to count relevant courses toward the BDP that satisfy other degree requirements is key to facilitating this variety in their course selections.

BDP certificates support students in charting an integrative educational path that allows them to make meaning of their learning in an interdisciplinary and transdisciplinary way, and they do so by drawing on the existing resources of the university—faculty, courses, research opportunities, and systems—while using them in a new way. The work required for this transformation can sometimes feel like swimming upstream—as the program makes systems designed for disciplinary divisions work for a curriculum designed for integration—but the impact of this work is evident in student and faculty engagement.

## Transforming the Research University through Transdisciplinary Curricula

The landscape for interdisciplinary and transdisciplinary educational opportunities looks very different today than before the BDPs were created, and these differences are apparent from the perspectives of student learning opportunities, faculty teaching and research, and the curriculum as a whole. In 1998, the Boyer Commission envisioned a “radical reconstruction of undergraduate education at research universities,” one that provides “a new kind of undergraduate experience available only at research institutions” (Boyer Commission, 1998). The BDPs have, along with other inquiry-based and integrative programs, helped move UT-Austin in the direction of some of the key recommendations for realizing that vision.

**Student Perspectives.** The BDPs were UT’s first significant foray into making college-bridging programs accessible to students across majors, thus offering new opportunities for integrating their studies. As of summer 2024, more than twenty-seven hundred students have graduated with BDP certificates, and BDP students and alumni give us insights into how the programs have impacted their educational experiences. In our exit surveys of students graduating between fall 2018 and spring 2022 (n=384, 44 percent response rate), students overwhelmingly self-reported that their BDP expe-

rience helped them learn about an interdisciplinary topic (99 percent agree) and gave them the ability to apply perspectives from multiple disciplines to their topic (98 percent). In responses to an open-ended question about what students liked most about their BDP experience, themes included the ability to take a variety of courses outside the major (41 percent of 294 responses); getting hands-on or real-world experiences through connecting experiences (24 percent); connecting with others (22 percent); and the ability to design their own learning plan or tailor their education to their interests or goals (21 percent).

Student comments in the exit survey describe the value students see in the integrative learning that the BDP facilitates. A student in the Social Inequality, Health, and Policy BDP noted that the multifaceted understanding they gained through the program had extended to other parts of their life: “I truly liked learning about how social inequality is caused from different disciplines. It enriches the way I think about life and made me realize that there is more than one way to combat social issues. In fact, a multifaceted approach is required.” Another student wrote, “I liked how [the program] pushed me to think about how topics are interconnected. I employed this mindset even in my non-BDP courses.” A third said what they liked most was the “emphasis on interdisciplinarity—super important going forward and solving big problems which will inevitably be multidimensional.” With the benefit of some distance and experience in the workplace and/or graduate programs, respondents to a survey of BDP alumni similarly describe the value of the integrative learning they did through the program. A graduate from the Environment and Sustainability BDP, responding nearly ten years after graduating, wrote, “In hindsight, the most valuable thing the BDP provided me—even required of me—was the real-world experience. The BDP not only bridges disciplines, but it also bridges academia with reality, theory with real life, ambition with practicality.”

**Curricular Transformations.** Although the BDPs were the first program at UT-Austin to make interdisciplinary and transdisciplinary curricula broadly available across majors, there have since been many new programs offering integrative learning. Within the core curriculum, all undergraduates entering in 2010 or later take a required first-year Signature Course; these introduce students to college-level learning through courses that emphasize interdisciplinary approaches across a variety of topics. In the past decade, there has been a proliferation of new minors and certificates, including many with

interdisciplinary foci. Individual colleges have also offered integrative programs for their own students.

BDPs have served as a testing ground for new interdisciplinary majors, with six highly successful majors having emerged directly from BDP certificate topics: International Relations and Global Studies; Environmental Science; Health and Society; Arts and Entertainment Technologies; Sustainability Studies; and Communication and Leadership. Collectively, these majors have graduated more than twenty-six hundred students with bachelor's degrees as of summer 2021. UT-Austin is invested in creating new interdisciplinary credentials; its new strategic direction, announced in 2022, pledges to “deepen the integration between instruction and experience, research and service,” and to “[t]ackle society’s biggest challenges in key areas of interdisciplinary strength” (University of Texas at Austin, 2022). The BDPs are frequently cited as a model for this vision.

**Research Transformations.** Recent efforts on the research side have raised the profile of transdisciplinary scholarship at UT-Austin, and some of these efforts have resulted in new opportunities for students. The Bridging Barriers Program, a grand challenge research initiative launched in 2016, is one example. These projects have resulted in new opportunities for undergraduates to participate in transdisciplinary research. A Geological Sciences major in the Environment and Sustainability BDP, for example, pursued a connecting experience working on a Planet Texas 2050 Bridging Barriers research team led by a faculty member in Classics. The student redesigned an isotopic analysis method to analyze archaeological samples and then trained graduate students on the research team to use the method, contributing to knowledge about ancient water management and human migration and mobility. Another of the Bridging Barriers projects, Good Systems, has led to the development of one of our newest BDP certificates, Smart Cities. Faculty working on the Good Systems project were interested in a smart cities-focused undergraduate program related to the focus of the research project, and because of that cross-pollination, we have been able to connect BDP students with research and other opportunities.

Other interdisciplinary and transdisciplinary research initiatives have included Pop-Up Institutes funded by the Office of the Vice President for Research, Scholarship, and Creative Endeavors. Like the Bridging Barriers projects, the Pop-Up Institutes, which provide an opportunity for cross-disciplinary research interest groups to focus on a common theme over an intensive, month-long period, have resulted in new opportunities for BDP

students and other undergraduates. For example, a 2018 Pop-Up Institute on Health and Humanities (organized by Pauline Turner Strong) contributed to the development of the Patients, Practitioners, and Cultures of Care BDP. A 2021 Pop-Up Institute called “Beyond the Future of Work,” which brought together nearly seventy researchers, activists, and advocates, included the participation of BDP students who were undergraduate interns with the Bernard and Audre Rapoport Center for Human Rights and Justice, which sponsored the Institute.

**Faculty Perspectives.** Faculty involved with the BDPs highly value the educational experience the program offers to students. In a 2022 survey of faculty serving on BDP panels, 94 percent of respondents (n=35, 24 percent response rate) agreed that they would recommend that colleagues agree to have their courses included in BDP curricula and offer to mentor BDP students. Survey responses show that faculty participate in BDP faculty panels because of their own values related to undergraduate education, even though institutional incentives largely reward research and departmental teaching. (Faculty who chair a panel or teach the one-credit interdisciplinary course receive a stipend; there is no stipend for serving on faculty panels or supervising student research and internships.) Responding to an open-ended question about their experience, one respondent shared, “My experience with the program, my colleagues in the program, and the students has been overwhelmingly positive. In some sense the BDP is what I think a university education should look like.” While this comment is typical of faculty responses, it is also clear that many faculty find it challenging to participate in transdisciplinary teaching and research at UT-Austin, and that they do so despite bureaucratic hurdles and professional disincentives. Responding to a question about challenges in participating in transdisciplinary teaching or research at UT-Austin, faculty noted that courses specific to the BDP (the introductory courses) are not counted as part of their regular teaching load; that disciplinary and departmental boundaries are difficult to overcome; and that “everyone seems too busy” to put in the time-consuming work required for interdisciplinary collaboration. Multiple respondents shared that within their departments, co-teaching is either tacitly or explicitly discouraged and co-authored papers are treated as less significant than single-authored papers for promotion purposes.

These faculty responses, which are consistent with the authors’ experiences as program faculty and director, reflect the fact that the BDPs were designed to work largely within and around the existing disciplinary struc-

ture of the university, not to change that structure. The BDPs rely on faculty who see their participation as service that aligns with their values as educators and researchers, despite the ways in which this service is (at best) inadequately valued by institutional incentive structures. Similarly, from a student perspective, even with so many new opportunities for engaging in integrative learning, more needs to be done to build interdisciplinary and transdisciplinary learning into the educational experience of students across the university. BDP student survey comments suggest that without the benefit of the BDPs, many students would not have had an integrative learning experience at all beyond the Freshman Signature course. Twenty-nine percent of the exit survey responses describing what students liked most about the BDP mentioned coursework, experiences, or other opportunities they would not have pursued if not for the BDP. Some representative responses include, “Having access to a wide variety of courses I wouldn’t be able to be a part of normally”; “It gave me the opportunity and time to explore what I would like out of life and potential careers that my major alone could not provide”; and “I was able to get different experiences that my major wouldn’t let me or discouraged me to focus on.” These and similar comments show that although students now have access to a wide variety of rich interdisciplinary and transdisciplinary learning opportunities, it is largely up to the individual student to take the initiative to pursue these opportunities. Despite programs like the Signature Courses and the BDPs, in many ways the default plan remains heavily focused on learning in disciplines.

## Conclusion: Looking Forward

To what extent have the BDPs transformed undergraduate education at UT-Austin? A respondent to the BDP Alumni Survey wrote:

The BDP was an unparalleled opportunity to get more than the normal, average college education experience. Perhaps the ‘normal, average’ college education experience today is more like what the BDP offered back in 2004/5 when I enrolled, but at the time it was revolutionary, and without it I would not have had the opportunities I had to combine interdisciplinary coursework, research, internships,

even a paid student job, and study abroad programs into an ‘outside the box’ college education.

In some ways, what the “normal, average” college education looks like has changed a great deal since 2005, when this student was among the first to graduate with a BDP certificate. An integrative, research-based experience is now accessible to a much larger set of students through an expanded array of BDPs and other programs. Whatever their interests, motivated students can find learning opportunities that engage them in these approaches.

In other ways, changes since the early 2000s have been more marginal. To be sure, interdisciplinary approaches are more prominent, whether through general education requirements like the Signature Courses or through courses peppered throughout the curriculum with integrative approaches. But for the students who do not choose to seek out opportunities like the BDPs, or who learn about the program too late, the university can still feel like a very siloed place. The vision represented by the BDPs may no longer be novel, but as a broader vision for an integrative approach to undergraduate education that serves all students, it is still aspirational. From a faculty point of view, it is also fair to say that their involvement in the BDPs, while rewarding, is a voluntary, passion-driven addition to their already intense teaching and advising workload. The BDPs were designed to make new kinds of opportunities available for students while operating within and around existing structures, and this largely remains the case.

A second Boyer Commission found that structural transformation has been all too rare across US research universities in the nearly twenty-five years since the original report. The Boyer 2030 Commission issued a report in 2022 that makes a sweeping case for reform at a structural level—for extending to all students the kinds of innovative approaches to education that emerged from the 1998 report: “Not all students have equitable access to the advancements of the past twenty years, nor are those advances consistently construed and supported. This reality, combined with a rapidly changing world, requires not that we begin afresh, but that we double down on the original Boyer Commission’s call for fundamental reform” (p. 6). To respond to this call, universities will have to build the kinds of opportunities offered through successful programs like the BDPs into the structure of university curriculum, not as an add-on for motivated students, but as part of the educational experience for all students. More flexible pathways through degree plans, greater access to courses across disciplines that are relevant to the

problems we face, opportunities to pursue hands-on learning that bridges the classroom with the world outside it—these strategies are key to a future of higher education that values transdisciplinary learning. If we are to make them part of every student's experience, they must become an intentional part of curriculum design and a recognized part of faculty contributions to teaching and service.

The success of the BDPs demonstrates the value of building integrative learning into the fabric of the curriculum and students' paths through the university. Providing a supportive structure to engage students in thinking in both interdisciplinary and transdisciplinary ways about their educational experience over the span of their undergraduate careers allows them to develop new ways of understanding and engaging with the complexity of the world and the problems we face. From an administrative point of view, creating a mechanism for experimenting with interdisciplinary programs without having to develop a separate infrastructure has been efficient, allowing for some topics to become majors while others are dropped (due to lack of student interest or curricular resources). For UT-Austin, the next step is to make forms of integrative learning across the curriculum part of the experience for every student. To do this, the university must build vigorously on the BDPs and similar programs, addressing the persistent structural barriers to transdisciplinary teaching and curriculum that continue to stand in the way of integrative learning. This would involve considerable investment in interdisciplinary and transdisciplinary hiring initiatives, undergraduate advising, and paid internships and research apprenticeships. More generally, the example of the Bridging Disciplines Programs is one path other research universities may wish to emulate as they focus on integrative learning for undergraduates.

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## 2. Transdisciplinary, Challenge-Based Education Design Using Knowledge Creating Teams from Five European Universities

### *A Case Study*

GEMMA O'SULLIVAN

We're going to move to the new paradigm like another phoenix. It's like a metamorphosis. ... We are moving and we are in the middle. I mean I'm quite sure that this is going to be the future for learning and the future for research. —KCT Member B

Over fifty years ago, in 1970, Eric Jantsch used the terms system and innovation to describe the systemic changes the university needed to become responsive to societal problems (Jantsch, 1970). Transdisciplinarity has the potential to drive system innovation through engaging research with societal needs, breaking down disciplinary “silos” within the university, and developing competencies or transversal skills to make education impactful (Barth, et al., 2014; Gibbs, 2017). However, despite European policy calls for transdisciplinarity (European Commission, 2024), evidence on how to implement transdisciplinarity and its impact educationally is lacking. This diminishes its potential for sectoral change. Added to this, there are multiple definitions, approaches, and foci within transdisciplinarity (Fam & O'Rourke, 2021; Klein, 2008).

European policy for transdisciplinary education began in 2017 when French President Emanuel Macron initiated policy to fund new networks of European transnational university structures—a step change in trialing and funding new approaches to systemic change. In 2017, Macron announced a course of action to re-establish a sovereign, united, and democratic Europe

through, among other things, the bond of culture and knowledge, to create “a feeling of belonging,” “the cement that holds Europe together” (Macron, 2017). This initiative led to a call in 2018 by the European Commission for European Universities or “transnational alliances of higher education institutions from across the EU that share a long-term strategy and promote European values and identity” (European Commission, 2019). These European Universities, to be composed of a minimum of three higher education institutions from at least three EU Member States or other Erasmus+ Program countries (full partner), were first and foremost experiments that would test different models of universities and university education. The desired elements were listed as follows:

- Curricula customized by students;
- Innovative curricula with innovative pedagogies;
- Enhanced staff and student mobility;
- Transnational knowledge-creating teams of students/teachers/researchers/businesses/regional actors/civil society actors addressing big societal challenges using a challenge-based approach.

In 2020, the European Commission requested that future alliances “must create a European inter-university ‘campus’, where ... transdisciplinary and transnational teams of students, academics and external stakeholders tackle big issues facing Europe (such as climate protection, democracy, health, big data, migration)” (European Commission, 2024).

While European universities piloted many models, this chapter focuses on one case study, which used the knowledge creating team (KCT) structure to design a trans-institutional, transdisciplinary, challenge-driven master’s program. This case study seeks to contribute to building a body of evidence to support the development of transdisciplinary education within universities by demonstrating a unique approach to the design of transdisciplinary education. As a research associate working within this European University (hereafter the Alliance), I worked within the Alliance to co-lead the design process—a unique and bespoke process that road-tested KCTs as an instrument for universities to design challenge-based learning educational programs.

In the first section of this chapter, I will outline what can be described as a European tradition of transdisciplinarity. I will then describe the European higher education policy context within which the call for European Univer-

sities emerged. The following section outlines how the Alliance was formed and how KCTs emerged as a solution to design a transdisciplinary program that drew equally on the research and educational strengths of all partner universities in the Alliance and as many disciplines as possible. This leads to a description of the composition and structure of the KCTs, followed by a broad description of the process of writing the bespoke transdisciplinary master's program. The final sections of the chapter give a brief description of methodology before I present themes that emerged from the case and suggest how the case study might inform systemic innovation to support transdisciplinary education.

## Transdisciplinarity

Transdisciplinarity first originated as part of a call for the reform of the university sector in the 1970s, most notably in the work of Eric Jantsch (1970). Jantsch used the term at the OECD Seminar on Interdisciplinarity in Universities in Nice in September 1970 and outlined the transdisciplinary approach in the resulting book published in 1972 (Apostel et al., 1972). For the past two decades, the term has enjoyed a growing popularity within higher education in Europe. It is cited within literature representing a view that higher education needs to be reoriented in the face of the challenges of sustainability (Sterling, 2004; Cincera et al., 2018; Fam et al., 2018) in addition to calls for accountability and trust of the sector (Gibbons et al., 1994; Stauffacher et al., 2006) and a desire for institutional and cultural change and development of the skills of innovation (Kueffer et al., 2012). External to universities, transdisciplinarity is seen as necessary to develop skills in researchers and as a means to increase university-society collaboration to solve complex societal challenges (European Commission, 2017, 2019, 2024). The OECD Global Science Forum report “Addressing societal challenges using transdisciplinary research” (OECD, 2020) affirms this in its recommended actions for supporting transdisciplinary research. In its 2020 report, the OECD recommends that universities need structures and mechanisms to build trusted long-term relationships with external actors that will support transdisciplinary research. They need to commit core resources to the development of transdisciplinary skills, methodologies, and practice development within their institutions. Transdisciplinary teams need to be resourced and sup-

ported by administrative and structural mechanisms (for example, governance).

Transdisciplinarity brings with it, for some, the dream of the unity of science when further specialization and indeed hyper-specialization are increasingly the norm (Nicolescu, 2007, 2010, 2014). Fam et al. (2018) suggest we consider transdisciplinarity not as a theory or method but as an approach. The following definition from the League of European Research Universities (LERU, 2016) articulates the differences between transdisciplinarity and multi/interdisciplinarity:

Multidisciplinarity (MD): sequential analysis of a problem by disciplinary experts with few interactions between them.

Interdisciplinarity (ID): growing interactions and efforts to integrate disciplinary insights with a scientific added value for the involved disciplines.

Transdisciplinarity (TD): interactions are extended outside academia to solve problems of societal importance through integration of knowledge from different actors. (p. 12)

The LERU definition reflects a new discourse on transdisciplinarity that has emerged in Europe. This builds on the concept of post-normal science (Funtowicz & Ravetz, 1993) and Mode 2 knowledge (Gibbons et al., 1994) and is aligned with sustainability and a new discourse of problem-solving (Klein, 2014). It represents a transparently values-driven science and is most prominently associated with the Swiss/German school of transdisciplinarity, which is connected to environmental research and has been described as a European transdisciplinarity movement for trans-sector, problem-oriented research involving the participation of stakeholders in society (Klein, 2008; Augsburg, 2014). In this Swiss/German school, transdisciplinarity is a process that is problem oriented, process oriented, participatory, practice oriented, and beyond disciplinary (Klein, 2018). This seeks both to reflect the era of complexity in which we now live (the age of the Anthropocene and human-environment systems) and marks a turn from “a science for society to a science with society” (Scholz & Steiner, 2015). The approach is highly normative—these are societally relevant problems (not economically driven).

The Swiss and German environmental research that developed this methodology began in the 1980s but acquired impetus when the Swiss

National Science Foundation (SNF) began the Swiss Environmental Priority Programme (SPPU) in 1991. The Swiss school has developed transdisciplinarity in hugely significant ways to support academic rigor, practical implementation, and usability. The approach is that transdisciplinarity has its own distinct theoretical structures, research methods, and modes of practice that pertain to a specific problem, arise in that context, and may not necessarily be transferrable to any other. Swiss researchers developed distinct frameworks to guide problem solving in the contexts of different problems. These support the goal of creating theoretical consensus that is strengthened by suitable empirical components. The Swiss approach aims at identifying, structuring, analyzing, and handling issues in problem fields with the aspiration (Pohl & Hirsch Hadorn, 2008):

(a) to grasp the relevant complexity of a problem, (b) to take into account the diversity of life-world and scientific perceptions of problems, (c) to link abstract and case-specific knowledge, and (d) develop knowledge and practices that promote what is perceived to be the common good. (p. 36)

In 1997, Swiss researchers produced a report, *Research on Sustainability and Global Change – Visions in Science Policy*, that articulated the need for science to submit three types of knowledge to public debate: systems knowledge about structures, processes, variabilities, etc.; target knowledge about the targets of future development and scenarios; and transformation knowledge about the transition from the current to a future target situation (ProClim, 1997). These were further explained as follows:

1. Knowledge of the current status: Systems knowledge of structures and processes, variabilities, etc.
2. Knowledge concerning that which may and may not be: Target knowledge, i.e. the evaluation of current situations, prognoses and scenarios; providing critical levels, “guiding ideas”, ethical boundary conditions, visions.
3. Knowledge on how to make the transition from the current to the target situation: Transformation knowledge, i.e. gaining knowledge on how to shape and implement the transition from the existing to the target situation. (p. 15)

The Swiss approach emphasizes the transdisciplinary team and what Klein (2008) refers to as democratic discourse. Transdisciplinary group identity is cultivated by team management and needs to be continually managed throughout the project. Heterogeneity is seen as a necessary element of success but also a challenge (Augsburg, 2014). Democratic discourse means integrating groups and individuals from across diverse sectors of society in the problem-defining, problem-exploring, research and knowledge production, and implementation cycle (Augsburg, 2014; Hirsch Hadorn et al., 2008).

## Transdisciplinarity as a New Policy Goal in European Higher Education

In tandem to the evolution of transdisciplinarity in the Swiss/German school since the 1990s, there has been an increasing leaning toward transdisciplinarity in European research policy. In 1999, the European Council's Lisbon Agenda identified the strategic role of higher education in Europe driving the creation of what was perceived as a dynamic, competitive knowledge-based economy, promoting an economic competitiveness that has universities at the center as a source of this human capital. It stated Europe's "need to adapt both to the demands of the knowledge society and to the need for an improved level and quality of employment" (European Parliament, 2000). The modernization of universities was seen as core to the success of the Lisbon strategy (Capano & Piattoni, 2011). Lisbon led to the Bologna Process, which, in 1999, began the reconstruction of higher education (Neave, 2003). The goal was to create a European Higher Education Area (EHEA) driving convergence in compatibility and comparability of academic qualifications. The two pillars of the Bologna Process were the creation of the EHEA by 2010 and the European Research Area (ERA). The ERA was developed as a supra-national initiative, to create a "single market for knowledge, research and innovation" (Cino Pagliarello, 2022). The European Commission stated that "the European Higher Education Area and the European Research Area must be fully open to the world and become worldwide competitive players" (European Commission, 2006). This competitiveness would be driven by the following policies:

- breaking down the barriers around universities in Europe;
- ensuring autonomy and accountability for universities;
- providing incentives for partnerships with business;
- providing “the right mix” of skills and competencies for the labor market;
- reducing the funding gap and making funding work more effectively in education and research;
- enhancing interdisciplinarity and transdisciplinarity;
- facilitating the interaction of knowledge and society;
- rewarding excellence;
- making the European higher education area and the European research area “more visible and attractive in the world” (European Commission, 2006).

In 2018 the European Commission agreed to a more ambitious EHEA through a focus on degree compatibility, quality, and compliance with European standards, as well as European higher education to play a key role in meeting the UN’s Sustainable Development Goals, or SDGs (Jungblut et al., 2020). The European University Initiative (EUI) can be seen as part of this goal for a more ambitious EHEA. By 2024, through the EUI, the European Commission directly funded sixty-four European Universities, involving more than five hundred sixty higher education institutions from all parts of Europe (European Commission, 2024). From 2021 to 2027, Erasmus+ will assign a record of approximately €1.1 billion to the European Universities Initiative (ibid). Many of the goals stipulated by the European Commission were a simple continuation of European policy terms for higher education: to increase mobility of staff and students and to strengthen quality, inclusiveness, and competitiveness of European higher education. It is the first time that elements of transdisciplinarity, which have been present in European research policy since 2006 (European Commission, 2006), are evident in European educational policy.

## The Alliance: A Brief Case Study

The EUI that is the locus of this research was formed in 2018 as a trans-institutional alliance to write the joint application to the European Com-

mission in response to the EUI call. It comprises five research-intensive European universities from five different European countries (see table 1): three high-ranked, mid-sized European universities located in prominent European cities; one mid-ranked regional French university; and one low-ranked accession state capital city university (Times Higher Education, 2024).

**Table 1: Profile of the five universities that formed the Alliance.**

University	Country	Times Higher Education World University Ranking	Total Student Population
A	Spain	152	44,365
B	The Netherlands	66	32,532
C	Ireland	134	18,778
D	France	301-350	40,734
E	Hungary	801-1,000	30,414

The Alliance sought to utilize the research and educational strengths (including staff) of five universities to create a transdisciplinary, challenge-based master's program that aligned with the UN Sustainable Development Goals and key European policy documents (e.g., the European Green Deal) in a manner that maximized the knowledge base and strengths of partners; utilized existing teaching staff from partners; connected the curriculum with the research activities of partners; implemented the principles of transdisciplinarity; and engaged extra-academic actors. As a research associate within the Alliance, my role was two-fold: to ensure the Alliance educational model was transdisciplinary and to carry out research on the creation and implementation of this transdisciplinary educational model.

## Knowledge Creating Teams and the Master's Program

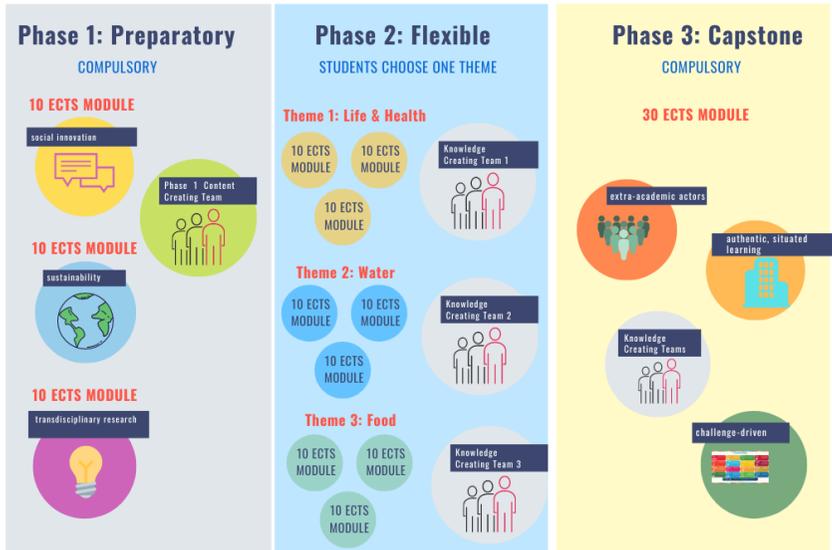
The primary goal of the Alliance was to pilot a transdisciplinary master's program as a means to test and create a trans-institutional, transnational, trans-

disciplinary university model. It was agreed that for the content to be truly transdisciplinary, transdisciplinary teams would need to design the program. The Alliance decided to put in place knowledge creating teams (KCTs) to design the master's content and teach the program. How to design a transdisciplinary program with KCTs, in under a month, was our "experiment," and two work packages within the Alliance (curriculum design and teaching and learning strategies) jointly designed a curriculum design process (called the content creation process) to support the development of transdisciplinary program content for the master's.

[Figure 1](#) illustrates the structure of the master's program, which consists of three phases of content: Preparatory, Flexible, and Capstone. Each student completes each phase of the program but can choose a theme, or challenge area, to focus on in the Flexible Phase. The content for the first two phases was co-created by KCTs that wrote detailed curricula integrating knowledge from multiple disciplines. The content for the final phase (Capstone) was dependent on the challenge area chosen by students and the extra-academic actor(s) with whom they collaborated.

# MASTERS IN GLOBAL CHALLENGES FOR SUSTAINABILITY

Co-funded by the Erasmus+ Programme of the European Union 



**Figure 1:** An illustration of the structure of the master’s program, which consists of three phases taken in sequence by master’s students. Each phase has a corresponding Knowledge Creating Team(s), comprised of academics from multiple disciplines from the five universities, which provides integrated content for the curriculum or challenge area chosen by the student(s). [See Appendix for a description of this image.](#)

In their call for EUIs, the European Commission did not provide any detail on the theory behind KCTs or guidance on implementation. In recruitment, there was considerable discussion among the work package leaders within the Alliance about the form a KCT would take and about whether a community of practice idea was most suitable conceptually. Communities of practice are defined as “groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly” (Wenger-Trayner & Wenger-Trayner, 2015). However, although the spirit of a community of practice (the community learns from each other and forms organically without managerial or institutional guidance) was attractive to some leaders within the Alliance, the KCTs were actually formed intentionally and given direction by the work packages and the project management team. The KCT members were recruited into a team and given tasks as a team. The only individual task was potentially teaching an element of a module.

The KCTs were, therefore, institutionalized networks formed by issuing a

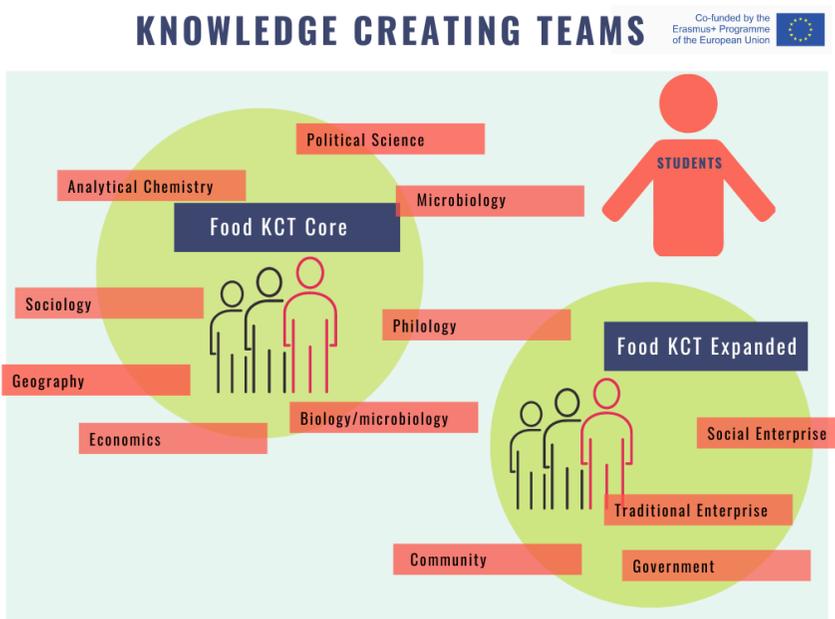
call for volunteers. The level of motivation interviewees expressed to take part in the masters' design is therefore a significant factor. Interviewees were motivated to take part to change the system. They were system innovators who sought to solve complex societal problems, respond to student needs and expectations, and reflect changing academic values. They expressed a keen desire to drive change and either frustration with an inability to implement their ambitions or a hope that partaking in this Alliance would allow them to form new ambitions. As KCT member I explained:

You work with higher education academics who've been in practice who would be territorial about their topic for so long, they're probably the wrong makeup to try and make transdisciplinarity you know. And I'm not saying it can't be done ... but if you look at the individuals in question. Because people won't be inclined to shift their thinking when they have minded their territory for so long, and I think that's what I was hinting at earlier that we do get into that fix a little bit. You know, sometimes people won't take a topic as they think 'I know nothing about this' or they won't read themselves into it. And that in itself can be, you know, a barrier to something like transdisciplinarity for the simple reason you know ... It's a bit like I was saying 'You're only qualified for one thing.' You know you don't want to look foolish.

The system innovation, therefore, was that the Alliance formed and resourced a network of academics open to innovation and transdisciplinarity that stretched across five universities. This had a very particular structure. The KCT structure was loose and was not directly managed. As a result of the diverse recruitment process, the support of KCT members from and within their home institution varied. From interview data, it appeared eight out of the ten interviewees were taking on this work in addition to a full academic role. Two interviewees had a small amount of their time bought out to facilitate their involvement in the Alliance, but in both cases that level of involvement was considerable (i.e., they were involved in many other aspects of the Alliance). All interviewees were members of the core KCT and, therefore, had undertaken a commitment to curriculum design and potential teaching duties for the master's program. KCT members were signing up based on an understanding that they were taking part in an experiment and that they would design this master's program and contribute to teaching on it. How the latter would be organized was not made clear to members. Thus, KCT

members joined a very loose staffing structure that was flat organizationally despite the presence of staff with differing levels of seniority in their own institutions.

We defined two types of KCTs (see figure 2): the Core KCT was a team of academics and researchers and the Expanded Network KCT comprised connected academics and extra-academic actors from traditional and social enterprise including government, for example, a staff member from an NGO, a representative from an engineering company working with hydrology or a local community organization in an area affected by flooding. We proposed to create a KCT for each phase of the master's program: Phase 1, which was called PICT (Phase 1 Content Team), a KCT per theme in the Flexible Phase of the master's, and a KCT for the Final Phase, renamed the Capstone Phase at this juncture. KCTs were recruited for the Flexible Phase and the Capstone Phase of the curriculum to research and design module content, teach and assess students, and build cross-institutional research networks. The purpose of the Flexible Phase was to bring the KCTs' disciplinary knowledge to bear on a challenge or problem to ground students' understanding of the context that surrounded a challenge.



**Figure 2:** Sample KCT structure for the Food theme. [See Appendix for a description of this image.](#)

Members of these KCTs were recruited through engaging with staff from partner institutions. Different approaches were taken to recruitment depending on the institutional and cultural context of the partner university. The initial success of the KCT recruitment and establishment process was identified through the large number of academic staff registering as a KCT member (n=188) and the broad range of disciplines. A total of seventy-five disciplines were represented, including philology, physics, media, law, economics, ecology, medicine, engineering, and social work. The final number of participants in KCTs before the fieldwork began was approximately thirty. There were four KCTs in place at this juncture: the Phase 1 Content Team (PICT), and a KCT per theme—Food, Water, and Life & Health—in the Flexible Phase. Each Flexible Phase KCT had two members per university. KCT members were initially nominated by the university based on their expression of interest form completed after attending the virtual town hall session. The KCTs were formed within weeks.

The Alliance had integrated extra-academic actors and students into the curriculum design early in the project, and the Alliance aimed to invite extra-academic actors at the master's design stage. This became very difficult for two reasons: the pandemic had reduced the ability to meet extra-academic actors and build relationships, and, secondly, staff connected to the project were under significant pressure due to extra workloads connected to pandemic issues. Consequently, the Alliance did not have sufficient opportunities, time, or resourcing to engage with a network of extra-academic actors. We were also informed at this point that due to program approval processes, the master's content would have to be written within a couple of months. We were conscious that although this deadline was achievable, it was going to put Alliance staff under significant pressure. While we were willing and able to adapt to this deadline, it would not have been possible to ask extra-academic actors to engage under such time constraints. We decided to write the content with KCTs and, thereafter, to engage the Expanded Network of KCTs and extra-academic actors in teaching the content and advising on/participating in challenges.

## Writing the Master's Program

The curriculum design for the master's took place over three weeks and comprised two content creation workshops. Facilitators were educational scientists who had reached a master's or doctoral level in educational science; three had senior management roles on the project. Workshop facilitators were introduced to best practice approaches to transdisciplinarity. I was one of two facilitators with expertise in transdisciplinarity, and we both worked with an educational scientist from the Dutch partner to support staff to write modules in their own content areas. An iterative approach to content creation was one of the guiding design principles. This approach embraced trial and error and allowed workshop facilitators to adapt to the needs of the team within their specific workshop i.e., Food, Water, or Life & Health.

The software Microsoft Teams was used to set up channels for the KCTs to communicate with each other. In addition, within the Alliance, I acted as a contact point for the KCTs. Ahead of the first workshop, KCTs were sent a questionnaire to collate information about members' academic and research experience and to collate members' suggestions to support the definition and categorization of problem spaces within the theme leading the KCT i.e., Food, Water, or Life & Health. Members were asked, for example, the following questions:

- Which societal challenges or issues are currently emerging within your KCT Theme?
- What kind of skills/knowledge/attitudes are required from future graduates to tackle these challenges?

The task was to collate and collectively examine the long list of societal challenges and collaboratively short-list problem spaces that could form modules. Team members decided to trial different approaches to short-listing: identifying repeated or cross-cutting challenge areas, ranking challenge areas, and finally creating umbrella "problem spaces" within which challenge areas would sit. The term "problem spaces" refers to focused challenges within each challenge area; for example, within the broad challenge area of "Food," KCT members listed "Food Security" as a problem space. The facilitators opened a Padlet, giving access to all members to post their shortlist.

On the Padlet, questions were posed such as: How can we give students as much depth as possible? How can we focus without losing depth of learning in the Flexible Phase?

The outputs of the first content creation workshop were agreed problems spaces and module titles within challenge areas, as well as a broad approach to how disciplinary content would be integrated, i.e., systems approach or challenge-based design. The output of the second workshop was a list of module learning outcomes and indicative module content. While each facilitator guided this process, we left the KCT to collectively discuss and agree on how this process might work. For example, within the Food KCT, we followed the structured knowledge integration process pioneered by Swiss researchers (ProClim, 1997) outlined on page 35. Following the ProClim framework, the KCT collaboratively wrote three transdisciplinary modules about Food Inequality: systems knowledge to frame the problem; target knowledge to frame the potential path to a solution; and transformation knowledge to frame solution or policy recommendation.

## Methods

I took part in the content creation process as both a facilitator and researcher and drew from notes, emails, official documentation, and video recordings of content creation sessions to inform the description of the case study. The case study was further deepened by two rounds of semi-structured interviews with academics (n=11) from multiple disciplines who took part in the design of the transdisciplinary master's program. Interviewees were asked a series of questions to establish their understanding and experience of the content creation process and where it had worked or not. The interviews were then coded and analyzed using thematic analysis, which allowed global themes to be signified, structured, and depicted (Attride-Stirling, 2001).

# Findings

## The KCT Structure

The KCT structure was an explicitly flat, multidisciplinary structure with a very broad number of disciplines. It was formed as a collective of individuals with no demarcated roles initially and equality of status. No one person was in a leadership role. As the network solidified, individual members agreed on role delegation, but these decisions were made within the network rather than by senior figures within the Alliance. The range of seniority, age, and gender was wide. We designed workshops and the structure to ensure that all members had equal status regardless of their seniority in their home institution. The KCTs became a community of co-creators on a shared learning journey. Interviewees reflected on the positive atmosphere of the KCT: they expressed team spirit, a spirit of a shared endeavor, and interviewees engaged reflexively, noting the intra- and interpersonal qualities and competencies necessary for themselves and others to function well within this loose structure but also for the loose structure to function well. A key indicator of the success of the KCT structure was the emergence of a shared narrative or collective narrative/identity (Wenger et al., 2011) on what transdisciplinarity is, how it can be nurtured in students and staff, and what competencies are needed to be transdisciplinary. One interviewee, KCT Member B, expressed this emergence of a shared narrative as a shift from “I” to “we”: “I changed in the middle of the past six months. So, I thought that it was the knowledge in the center or the disciplines and the interaction of the disciplines in the center. Now we think it should be the society in the center.”

From the beginning, we started working as a team because we were starting with the idea that we are constructing, we're producing something new. So it was not: 'OK, this is my part of knowledge. I want to put this part of the content because they want to be teacher of this.' No, it was not like: 'This is my discipline I want to introduce part of my discipline in this curriculum.' It was the other way around. It was: 'OK, this is the theme that should be important. There are a lot of things that are important to this. And from the different perspectives, we are adding new things.' This was nice because probably from

the beginning we're thinking about a common challenge and this is the way we work, I mean for us. —KCT Member B

This parallels literature on successful transdisciplinary research, which demonstrates that successful transdisciplinary research hinges on creating and managing successful transdisciplinary teams (Hollaender et al., 2008). High levels of motivation and shared values from the outset fired a sense of connection and collective efficacy. This attention to and the importance of building relationships was seen as important to the process and was also necessary when building relationships with extra-academic actors. KCT members each acknowledged that transdisciplinary work requires inter- and intrapersonal competencies in addition to disciplinary knowledge.

## The KCT Challenge-Driven Design Process

All interviewees spoke of the importance of the KCT dynamic and structure in the curriculum design process. The KCT structure supported academics to form a network that delimits a problem area and integrates varied disciplinary expertise, thus successfully designing transdisciplinary education. Crucially, the KCT decided if transdisciplinarity had been achieved in content design. Interviewees noted that at different stages each group realized there was a need for an integration framework or methodology within their problem space, e.g., Food, Water, or Life & Health. Interviewees regarded integration as necessary to give depth as well as breadth to the learning experience through integrating disciplinary expertise: “although it was complicated, we finally agree on the narrative beyond disciplines. So this is already one indicator of success.” —KCT Member H

Focusing on a challenge created space for flexibility in what content was integrated. Interviewees recognized that a challenge is necessarily a loose design and that ultimately the choice of expertise to be integrated would vary depending not only on which experts were involved but also on the student journey, i.e., which aspect of a challenge students chose to focus on. For example, KCT Member A described the process of choice as experienced by one of the KCTs:

It will take a lot of time to involve a lot of things. So we agreed: we have problems with water quality and quantity and then OK but we

have sea level rise. We have seawater intrusion on the coastal areas. We have droughts and floods and climate change and then we have problems within cities which are not involved. Rural areas. Yeah, of course you cannot involve all of these things, but I think that's what this is about [the Alliance] because it's flexible. So we agreed to create module titles as broad as we can to be able to modify during the year the content so it can be a bit flexible. And adjust it to new challenges.

## KCT Curriculum Ideology

A clear curriculum ideology—defined by Lyall et al. (2015) as principles, ideas, beliefs, and epistemologies—emerged within the KCTs and was articulated by interviewees. This ideology can best be described as a desire for actionable knowledge, described by Argyris (1996) as knowledge required to implement external validity. KCT Member A expressed this succinctly as follows:

I got what transdisciplinarity is and in my view it is not taking the [disciplinary] content into the core, but rather to question a challenge and then connect all the other disciplines or fields which are related. ... And the other thing is the key importance of stakeholders, which can be the society or even a company. What would implementation look like if it was successful? You can solve the problem.

The KCTs coalesced around an ultimate goal of making their knowledge relevant to the challenge area at hand. Academics who participated in the KCT and content design process defined success within transdisciplinary education in a manner similar to transdisciplinary researchers. Success is the activation of expertise to delimit a complex problem; manage contested problem definitions; articulate an appreciation that not everything can be known; understand and manage real-world constraints on handling a problem; and appreciate and accommodate the partial and temporary nature of solutions (Bammer et al., 2020).

# Discussion

Impediments to inter- and transdisciplinarity are well-documented in the literature: the structure and separation of education into schools and departments (Vienni Baptista & Rojas-Castro, 2020; Charli-Joseph et al., 2016; McGregor & Volckmann, 2011; Chettiparamb, 2007); the instability and short-termism of inter- and transdisciplinary funding mechanisms (National Research Council et al., 2014); and a lack of theoretical frameworks and curriculum ideology (Lyall et al., 2015). Solutions are also well-documented: changes in governance to support inter- and transdisciplinary work; improvement in inter- and transdisciplinary funding mechanisms and evaluation; support for inter- and transdisciplinary researcher training and skills development; cultural change in academia; university to reward transdisciplinary research through reducing teaching load, creating project grants and fellowships, providing residency programs for visiting scholars; and the need for universities to recognize that producing high-impact publications from transdisciplinary research is challenging (Gibbs, 2017; LERU, 2016; National Research Council et al., 2014). This case study provides evidence that the KCT structure, as proposed by the European Commission, is a valuable additional proposal. The collective as an alternative structural proposal that is successful in facilitating transdisciplinary education is an important finding in this research. This utilizes the strengths of the system. It takes the pillars of the university—its disciplinary depth and expertise—and provides a conduit for it to feed iteratively to societal challenges. However, it is clear that this structure needs to be resourced and supported within the university system.

The KCT structure protects the integrity of disciplines but allows motivated staff to be seconded to a timebound and nimble structure. Members of the KCT structure can come and go, unlike research teams, which are formed in response to time-bound funding opportunities. The KCT also supports cultural change within the academic community by bringing together academics who are similarly motivated. Charli-Joseph et al. (2016) argue that collaboration within the university system can counterbalance resourcing constraints, lack of experience, and “silos.” The KCT structure was designed to be highly collaborative, and, in their interviews, all KCT members said they saw this act of collaborating as integral to transdisciplinarity. It is difficult to separate the development of this team bond from the process they engaged

in, but interviewees were motivated and expressed values that aligned with a more democratic approach to academic team formation—i.e., a flat structure. They saw this as happening through the integration of multiple sources of expertise with equal standing and even representation (i.e., one discipline present).

The success of the KCT-led design process affirms a widely held view within the literature on transdisciplinarity: that both a clearly defined problem-solving methodology and integration methodology (Bammer et al., 2020; Hoffmann et al., 2017) are needed in transdisciplinarity to avoid deliberations becoming too diffuse. KCTs in their responses listed the following elements that needed to be realized in transdisciplinary curriculum design: collaboration; extra-academic actors; complexity; integration; challenge-focus; impact-driven; flexible; student-centered. Interviewees viewed the transdisciplinary educational experience as a process rather than a series of milestones in learning or goals to be reached.

This case also affirms the view that uncertainty can be part of transdisciplinary education—both for staff and students (Clarke & Ashworth, 2018).

I suppose you do have to move outside of your comfort zone, like move away from what you're familiar with. ... I would look at a question or whatever, specifically from my own kind of background and perspective. So I suppose being able to kind of move away from your comfort zone and try to think about whatever it is you're addressing from the perspective of multiple different subject areas. So that was a bit of a learning curve. —KCT Member G

The key challenges listed by interviewees related to the constraints of the system. These were the need to meet institutional requirements for program approval (for example, the need to have module learning outcomes) and timetabling both staff and contact hours for students for a program that may not have traditional lectures. However, when interviewees were asked about the key challenges of the process, they overwhelmingly cited time, or lack thereof, as a disabling factor. Half of interviewees expressed frustration at what they saw as an increased and unsustainable draw on their time. They said this ran contrary to what they saw as their role and the principle of innovation. Their responses varied depending on the support they had received from their home institution to take part in the process. One interview (KCT Member I) spoke of the need for commitment from a staff mem-

ber's home institution: "To get something like this working, you've got to get commitment and you need to know what the commitment is from the outset." All interviewees highlighted the lack of involvement of extra-academic actors and recognized that this was due to time constraints.

KCT members experienced uncertainty on many levels: they expressed concern about the quality of the content they were creating; they were worried it might lack depth; they were concerned they were leaving out important disciplinary information; they were concerned about the dominance of STEM over the humanities; they did not want to dominate with their disciplinary expertise, and they worried that others might not understand them; they worried there was no common language. The biggest challenge, one interviewee said, was that we are moving from an old paradigm of teaching to a new one. KCT Member B described it as follows:

You are thinking that you are at the top of the pyramid and so you are at the top of the knowledge—the academic/the university. And now that change of paradigm means 'OK. We don't have the truth. We are only another element.' So students, members of society, everybody can have a role in this. I don't know what the problem is about water in the South. Power in the north part of Africa? You have to ask that people that are living there. I can just help.

## Conclusion

In this chapter, I sought to open the "black box" on the use of KCTs as a new organizational mechanism to develop transdisciplinary education. This research focuses only on the design process, rather than implementation of this master's program, which due to time constraints was outside the scope of this case. The KCT approach piloted through the EUI call has the potential to support the creation of transdisciplinary education programs that integrate disciplinary expertise in a meaningful way. This can release the potential of the sector to develop a new generation of graduates and researchers equipped to use their disciplinary expertise to impactfully tackle societal challenges. Within the EUI, universities have been requested to disseminate their experiences as models of best practice. This is an important opportunity to also critically examine the resources and structural changes needed

to support educational innovation within the sector. While the EUI policy recommends KCTs, it could go further by introducing rewards or funding models to support permanent institutional recognition pathways for academics who do transdisciplinary work in education or research. As enthusiastic as KCT members might be—motivated by a desire to contribute to societal challenges, for example—most universities still cling to traditional promotional milestones: publications and funding success. These are still the systemically forced foci of academic work—rather than what society actually needs.

## Acknowledgments

I would like to acknowledge all members of the Alliance work package teams, with whom I worked in a close team structure to co-design the educational principles and implement the KCT recruitment process. In particular, I would like to acknowledge the work of Dr. Tim Savage, with whom I co-led the curriculum design process. I would especially like to acknowledge the content design workshop leaders and the members of the KCTs, who designed this hugely innovative master's in little more than three weeks, mid-pandemic, during the summer of 2020.

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## Appendix: Image Long Descriptions

### **Figure 1:**

The first phase is Preparatory, which is compulsory and includes content on social innovation, sustainability, and transdisciplinary research. The second phase is Flexible, in which students choose one theme to focus on, like Food,

Water, or Life & Health. The third phase is Capstone, which is also compulsory and involves extra-academic actors; authentic, situated learning; and is challenge driven.

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### **Figure 2:**

This infographic provides an example of what kinds of fields could be present in the core and expanded knowledge creating teams—represented by two separate circles—under the Food theme.

The core knowledge creating team circle includes analytical chemistry, political science, microbiology, philology, biology/microbiology, economics, geography, and sociology. The expanded knowledge creating team circle includes social enterprise, traditional enterprise, government, and community. Tangential to both of these circles are students.

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### 3. Evaluating and Scaling Best Practices in Interdisciplinary, Project-Based Learning

EDWARD J. BALLEISEN AND LAURA HOWES

A middle-aged woman sits in the emergency room seeking care for her diabetes. Uninsured, she lives in an area without ready access to fresh foods and vegetables, depends on public transportation, and has limited command of English. Over the past year, she has made several visits to the emergency room, during which physicians have helped to adjust her blood sugar levels. But the ER lacks the capacity to connect her to the social services necessary to help her maintain a regular treatment plan.

In 2018, a team of undergraduate and master's students and a medical school faculty member from Duke University partnered with Lincoln Community Health Center in Durham, North Carolina, to address such gaps in care. The team piloted Help Desk—a new service delivery model in which trained students link patients from under-resourced communities to wrap-around social services. By focusing on non-health factors linked to health outcomes, such as access to food, housing, and transportation, Help Desk aimed to improve patient outcomes. Over several years, the corps of student volunteers has grown and now services three health care facilities. At every phase of this undertaking, interdisciplinary research has informed program design, evaluation, and adaptation.

From its earliest days, Help Desk was part of a Duke University program called Bass Connections, which supports interdisciplinary, applied research teams involving faculty, staff, graduate/professional students, and undergraduates. [Sixty to seventy year-long project teams](#) run annually, involving more than a thousand team members, with most students receiving academic credit. The program also supports collaborative, applied [summer research experiences](#) and a growing number of [semester-long courses](#) designed around team-based research.

In addition to improving the provision of health care and social services in Durham, Help Desk has shaped the skill development and career paths of

many student participants. Grace Lee '23, a neuroscience major, remarked, "I've learned so much about how to stay organized, to be better at time management and communicate with different groups of people. The program transformed my college experience." Katherine Kutzer '21, a pre-med student, reflected that "the work we've done has prepared me to be a culturally competent doctor—someone who's actively seeking ways to broaden my perspective about the communities I seek to work with" (Ozernova, 2022). Faculty and students on the team have also produced a growing corpus of more "traditional" academic outputs, including conference presentations and peer-reviewed journal publications.

Help Desk offers just one powerful example of the potential for applied academic research programs. As the faculty and staff directors for Bass Connections, we believe the program offers important insights for how other higher education institutions can blend experiential learning and interdisciplinary, community-engaged inquiry. In this chapter, we outline the emergence and evolution of this multi-faceted undertaking. We also explore the roadblocks to scaling such endeavors and embedding them within colleges and universities.

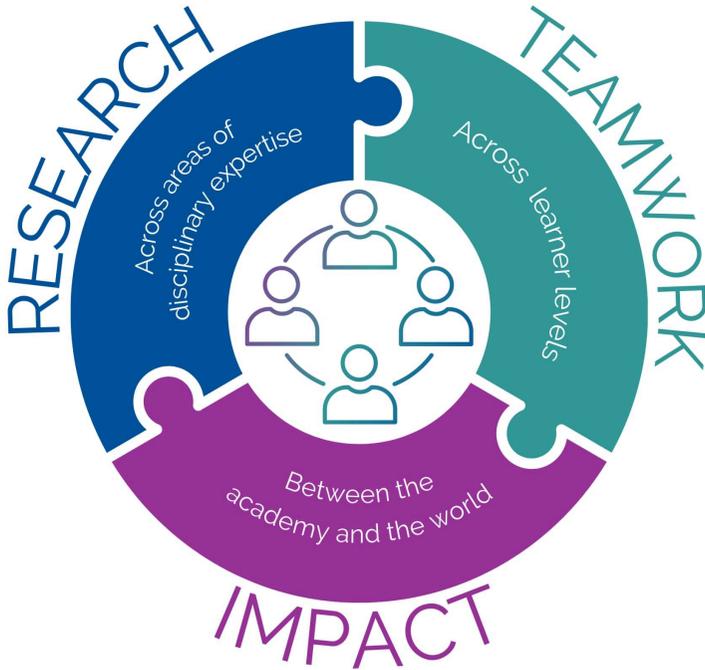
## Origins and Evolution

After a two-year planning process, Bass Connections launched in 2013 with the goal of harnessing Duke's strengths in interdisciplinary research to better equip students to become agents of change. Duke's leaders wished to create a curricular framework that would catalyze opportunities for faculty and students at all levels and across all divisions of knowledge to collaborate on applied, interdisciplinary research projects.

Given the aspiration to reach undergraduate and graduate students from every school, Duke placed the program in the Office of the Provost under the Vice Provost for Interdisciplinary Studies. To underscore its emphasis on applied inquiry, university leaders anchored research teams in five cross-cutting "themes": Brain & Society; Education & Human Development; Energy & Environment; Global Health; and Information, Society & Culture. Each theme was an identified focal area for the university and each administered by a university-wide unit under the ambit of interdisciplinary studies. The resulting program model integrated **three core connections**—engagement

across epistemological expertise (interdisciplinarity), learner levels (layered mentoring), and the academy and the broader world (application).

## THREE CORE CONNECTIONS



**Image 1:** Elements of the Bass Connections Model. [See Appendix for a description of this image.](#)

Annually, the program now reaches more than twelve hundred members of the Duke community through approximately seventy year-long teams and forty summer research projects, with an additional fifty affiliated courses. During the program's first decade, more than seven hundred fifty faculty led projects, from every school and proportionately distributed across ranks, with four hundred fifty choosing to do so more than once. They have been joined by more than five thousand Duke students, scores of Duke staff members, and several hundred external partners.

The year-long project teams tackle applied research challenges initially framed by two to four faculty leaders, usually from different disciplines. Fac-

ulty team leads select graduate and undergraduate students from a pool of applicants. Student composition varies, but the average team includes three graduate or professional students and nine undergraduates. External partners have included cultural institutions, government agencies, community organizations, health care providers, nonprofits, and firms. Students typically receive academic credit for participating, with some advanced students receiving compensation. While the academic crediting structure has gone through several permutations, the current system allows team experiences to count toward some general education requirements, as well as experiential learning expected for some majors and certificates. Undergraduates can also petition for credit toward their major when a team's focus has strong topical alignment with a given department. Most faculty participate without receiving teaching credit but instead receive funding to support research expenses (averaging \$20,000 per team).

We emphasize interdisciplinary collaboration out of the conviction that complex societal problems call for the integration of knowledge across fields. That said, the degree of intellectual convergence that occurs through project teams exists along a continuum, with some projects being better defined as multidisciplinary (involving multiple disciplines, but with limited integration), whereas others blend divergent conceptual frameworks and research methods in ways that would best be defined as transdisciplinary (Choi & Pak, 2006). For simplicity and in alignment with Duke's nomenclature, we refer to the program as interdisciplinary.

Although faculty leads frame focal points for project teams, we expect them to foster dynamic collaboration that enables all team members to participate in decision-making and contribute toward shared goals. Projects should provide students and faculty the opportunity to grapple collectively with a complex problem and produce meaningful deliverables. Teams have extensive leeway in deciding how to undertake research and share findings, so they pursue myriad approaches to question-framing, the development of research agendas, modes of analysis, and the creation of research outputs. The latter include traditional academic endeavors like grant proposals, data sets, and peer-reviewed scholarship, but also creative public-facing outputs, including new service delivery models and processes, policy briefs, prototypes, algorithms and software, exhibits, websites, oral history archives, and works of art. Table 1 gives a flavor of the diverse approaches across project teams (Howes & Balleisen, 2022).

**Table 1: Sample of the range of topics, disciplines, methods, and outputs of Bass Connections teams.**

Team Name	Disciplines Involved	Activities & Methods	Team Outputs
Representing Migration through Digital Humanities	<ul style="list-style-type: none"> <li>• Geography</li> <li>• Computer Science</li> <li>• English</li> <li>• History</li> </ul>	<ul style="list-style-type: none"> <li>• Archival research</li> <li>• Literature reviews</li> <li>• Data collection</li> <li>• Data Mapping and visualization</li> </ul>	<ul style="list-style-type: none"> <li>• Digital map cataloging deaths of enslaved persons in the Atlantic from 1750–1850, accompanied by a story map and reflections on the lives of those lost in the Middle Passage</li> </ul>
Impacts of Artisanal Gold Mining in the Peruvian Amazon	<ul style="list-style-type: none"> <li>• Biology</li> <li>• Ecology</li> <li>• Environmental Science</li> <li>• Global Health</li> <li>• Law</li> <li>• Policy</li> </ul>	<ul style="list-style-type: none"> <li>• Soil and water sample collection and analysis</li> <li>• Interviews</li> <li>• Engagement with government policy makers</li> </ul>	<ul style="list-style-type: none"> <li>• Data set showing spread of mercury through the environment and impact on human health</li> <li>• Policy report for Peruvian government, leading to delivery of food aid to communities reliant on river fishing</li> <li>• Publications and external grants</li> </ul>

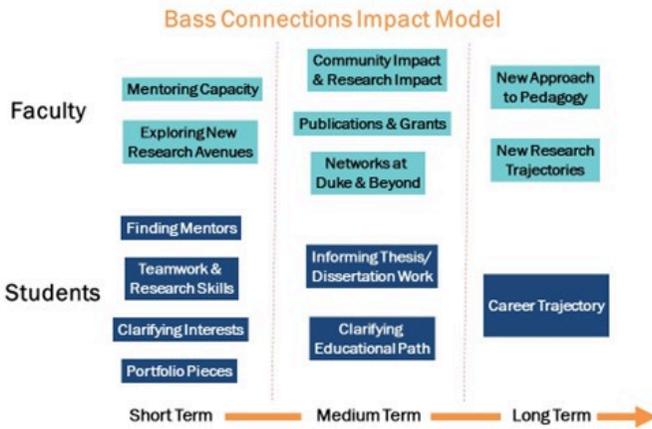
<p>Pocket Colposcope</p>	<ul style="list-style-type: none"> <li>• Biomedical Engineering</li> <li>• Business</li> <li>• Global Health</li> <li>• Law</li> <li>• Medicine</li> <li>• Policy</li> </ul>	<ul style="list-style-type: none"> <li>• Testing and refinement of a low-cost, portable device for cervical cancer screening</li> <li>• Supply chain analysis</li> <li>• Regulatory landscape analysis</li> <li>• Field interviews with patients and providers</li> </ul>	<ul style="list-style-type: none"> <li>• Regulatory approval to deploy device in several developing countries</li> <li>• Provider training program</li> <li>• Publications and external grants</li> </ul>
<p>Migration and Deportation among Guatemalans in the US and Guatemala</p>	<ul style="list-style-type: none"> <li>• Computer Science</li> <li>• Economics</li> <li>• Global Health</li> <li>• International Comparative Studies</li> <li>• Political Science</li> <li>• Policy</li> </ul>	<ul style="list-style-type: none"> <li>• Secondary data analysis</li> <li>• Field work interviews</li> <li>• Original survey data collection</li> </ul>	<ul style="list-style-type: none"> <li>• Discussion guide for educators on a documentary on Guatemalan migration</li> <li>• Data set analysis</li> <li>• Papers and op-eds</li> <li>• Funding proposals</li> <li>• Academic and policy papers</li> </ul>

## Assessing Impact and Sharing Lessons Learned

Although the faculty and administrators who designed and launched Bass Connections had exemplars in mind, their ambitions were unique in three regards: scope (covering all disciplines and all student levels), scale (the program launched with thirty-seven project teams), and provision of academic credit. Program administrators embraced an experimental mindset and adopted a flexible model that encouraged faculty to try new approaches.

Likewise, the faculty overseeing each “thematic” area of the program had the leeway to test different program offerings.

From the outset, we paid close attention to the experiences of students and faculty. In the first several years, specialists in program evaluation used a “developmental” method appropriate for innovative programs, relying heavily on end-of-year surveys of both team leads and students, supplemented by occasional focus groups. Instead of seeking to assess outcomes, evaluators identified opportunities for improvement. A university-wide committee also met regularly to create a logic model, define long-term goals, and identify necessary inputs to achieve them. Figure 1 describes key program goals, for both students and faculty and over different time scales.



**Figure 1:** Anticipated short- and long-term outcomes from the Bass Connections program. [See Appendix for a description of this image.](#)

More recently, our evaluation efforts have taken a more outcome-based approach. Refinements have included: a mid-year student pulse survey; a pre- and post-participation assessment of undergraduate students, benchmarked against a comparison group; an alumni survey; and a long-term faculty survey. These evaluation efforts have illuminated a wide-ranging set of impacts (Bass Connections, n.d.).

## Undergraduate Student Impact

Our most intensive efforts to measure outcomes have focused on undergraduates. We have found that the program has helped undergraduate students develop new skills, build important mentoring relationships, and gain clarity about their future goals (Balleisen et al., 2023).

**Skill Development.** Over three years (from 2019–2020 to 2021–2022), undergraduate students completed a self-assessment before and after participation in the program. This survey asked participants to gauge their strengths in twenty-six skills relevant to collaborative, interdisciplinary research. A comparison group of non-participating students received the same instrument. In each year, students participating in Bass Connections reported statistically significant gains<sup>1</sup> in multiple survey areas, including fourteen gains in 2019–2020, ten in 2020–2021, and six in 2021–2022. Students in the comparison group did not report statistically significant gains on *any* of the survey items in *any* year. When combining results across the three years, program participants reported significant improvements for at least two of the three years in the following eight areas (Howes, 2022):

- Developing an actionable research question
- Identifying appropriate research methods based on a given research question
- Developing a plan to execute on a long-term project
- Navigating the IRB process
- Effectively communicating my ideas to faculty and students from different fields of study
- Building on the ideas of others to move a team forward
- Feeling comfortable providing input to individuals more senior than myself (e.g., faculty)
- Helping define a role for myself when I am unclear about roles on a team

A survey of the program's undergraduate alumni produced complementary findings. Respondents reported that the top three skills they developed through the program were as follows: (1) critical thinking and analysis, (2) the

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1. Measured as a confidence level of  $p < .05$

ability to demonstrate leadership on a team, and (3) research skills. When asked to select the *one* most important outcome of their Bass Connections experience from a list of nine options, undergraduate alumni most commonly selected: “it gave me practical experience” (24 percent) and “it helped me develop important skills that I rely on today” (19 percent; Socha & Howes, 2021).

**Relationships.** The evaluation data also underscore that the vertically integrated team model deployed by the program fosters close working relationships across levels. The infusion of interdisciplinary approaches enables participating students to contribute complementary skills and facilitates near-peer mentoring. Indeed, from 2019 to 2022, 64 percent of undergraduates reported that Bass Connections helped them “develop new relationships outside of their social circles” by either “quite a bit” or a “great deal,” and 64 percent also said the same for the extent to which the program helped them “develop a meaningful relationship with a faculty member.” In addition, 29 percent of all student alumni reported that they remained in touch with faculty and students from their team, while 14 percent of undergraduate alumni said that the single most important outcome of their Bass Connections experience was developing a meaningful mentoring relationship.

**Research Pathways.** From 2015 to 2021, Bass Connections students graduated with distinction at a 16 percent higher rate than non-Bass Connections students and received Latin honors at a 12 percent higher rate. These results may reflect the tendency of research-focused students to seek out research-inflected opportunities. Yet we know from tracking the subject matter of student theses that participation on a team frequently shapes the choice of thesis topic.

Participation also influences decision-making about further education. Just more than half of undergraduate alumni responding to our survey reported being enrolled in a graduate/professional program. Of that group, more than two-thirds reported that Bass Connections guided their pursuit of graduate studies and nearly four out of five reported that Bass Connections helped prepare them well for those further studies.

**Academic Passions and Post-Graduate Goals.** Perhaps most importantly, student reflections and survey responses indicate that the opportunity to delve deeply into an issue over the course of a year can have a transformative impact on undergraduates’ understanding of their intellectual passions and future trajectories—even if sometimes that includes learning that they are not interested in something they thought they might be. The third most

common response that undergraduate student alumni who participated in Bass Connections cited as the single most important outcome of their experience was, “it helped me find a career interest I’m passionate about” (18 percent). In addition, 73 percent of alumni reported that Bass Connections influenced their post-graduation trajectory. As one alumnus shared: “Participating in Bass Connections helped me further my interests in statistics and education and clarify which avenues of pursuing those interests would be the most impactful and best fit for me.”

## Graduate and Professional Student Impact

Our efforts to evaluate outcomes for graduate and professional students have been less intensive due to the varied and decentralized nature of graduate and professional education. Nonetheless, our annual surveys, focus groups, alumni survey, and student reflections cumulatively show that for many graduate/professional students, Bass Connections facilitates the development of transferrable skills, clarifies research and career interests, and facilitates networks beyond the confines of degree programs.

**Skill Development.** When graduate/professional students were asked on our annual survey to rank the top three skills they developed, respondents most frequently selected the capacity to organize and manage projects; work with team members from diverse areas of knowledge; and communicate with a team—critical skills regardless of one’s career path (table 2).

**Table 2: Top skills graduate/professional students report developing through the program (2019–2020 to 2022–2023, n=565).**

Skill	Rank 1	Rank 2	Rank 3	Total
Organizing and managing projects	52	77	101	230
Working with team members from diverse areas of knowledge	28	70	98	196
Communicating with a team	34	60	100	194
Demonstrating leadership on a team	34	45	75	154
Mentoring others	40	49	63	152
Content knowledge/expertise related to our team topic	36	30	76	142
Research skills	30	68	39	137
Ability to connect academic experiences to social issues	22	46	32	100
How to collect/analyze data	21	33	31	85
Comfort working with faculty	9	12	54	75
Working with external stakeholders	9	25	20	54
Presentation skills	3	23	26	52
Solving complex problems	8	15	24	47
Developing new networking connections	6	6	22	34
How to write an academic paper	2	6	17	25
How to develop a grant proposal	4	6	8	18

**Career Experience and Direction.** When graduate/professional alumni were asked to select the single most important outcome of their Bass Connections experience from a list of nine options, the top responses were: “it gave me practical experience” (40 percent), “it helped me develop important skills that I rely on today” (21 percent), and “it helped me find a career interest I am passionate about” (13 percent).

As one PhD student reflected, for some students the experience also helps illuminate new possibilities for applying their expertise:

My participation in this Bass Connections project is one of the most meaningful and rewarding Duke experiences I have had. It not only helped me land my first job, but also helped me find my true passion.

Being a PhD student in science, my daily routine used to be doing experiments in the lab, going to research seminars, reading and writing papers and grants. Participating in this project has opened a door and led me to a completely new world. I got to work with an interdisciplinary team, learn from distinguished professors and scholars, interact with innovative social entrepreneurs and apply my ability to solve real-world problems. In this process, I found my real interest and passion, and I found what I'm good at. (Wang, n.d.)

## Faculty and Research Impact

Participating faculty point to a variety of motivations and benefits. Common themes include the ability to test out ideas and launch new avenues of research; deepen partnerships with external organizations; gather data to scale or sustain existing projects; and engage in close student mentoring. In addition to surveying faculty annually, the program regularly tracks team outputs. In 2019 we administered a comprehensive survey to faculty who participated in the program's first five years to ask about longer-term impacts. Key findings from this report (Nam & Howes, 2020) include:

**Research.** Bass Connections teams played an important role in securing forty grants totaling \$19.8 million, resulting in a more than 500 percent return on investment on the funding provided to responding teams. Half of respondents reported at least one project team-related publication, with many noting multiple publications. And nearly two-thirds of respondents agreed that their Bass Connections experience increased their willingness to engage in collaborative research.

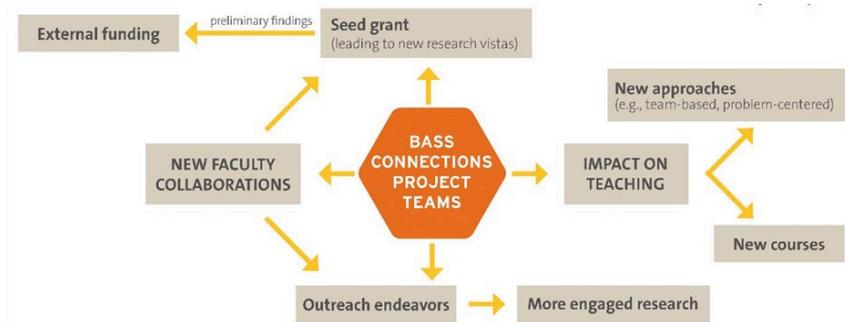
**Community Impact.** Fifty-eight percent of respondents agreed that Bass Connections helped them connect their research to some external community.

**Pedagogy.** Sixty-seven percent of respondents agreed that Bass Connections made them a better teacher, with written responses emphasizing positive impacts on project management, leadership, and understanding of student motivations. Nearly three out of four also agreed that they were now more willing to engage undergraduate students in their research. Written survey comments elaborated on these payoffs:

The Bass Connections program and “team” have been an incredible

benefit to our research. This opportunity and the team we've been able to bring together each year has been the cornerstone of this specific project and ultimately has, and is, providing continuing proof-of-concept, preliminary/pilot through mature findings, support toward building community partnerships and bringing together numerous perspectives within our undergraduate team members based on their varied fields of study that are ultimately supporting the growth of the project and growth of individual undergraduate researchers in their personal academic journeys.

Figure 2 suggests the varied pathways through which Bass Connections has influenced faculty approaches to research, teaching, and engagement.



**Figure 2:** A visualization of how faculty have leveraged Bass Connections projects. [See Appendix for a description of this image.](#)

For all the benefits that participating professors have identified, the model as implemented at Duke—in which faculty do not receive teaching credit—has consistently confronted critiques about the amount of time required to organize and lead these interdisciplinary research teams. While we have developed resources to ease the burden of leading teams, teaching credit would make the program more attractive. We also recognize that many forms of important research and teaching do not lend themselves to interdisciplinary, collaborative approaches.

## Lessons Learned

The experimental ethos of the program has allowed us to pinpoint factors underlying successful interdisciplinary teams of faculty and students. We have consistently drawn on these insights to foster best practices in every phase of the program, while maintaining space for faculty to adapt the model to the distinctive needs of their research projects. For faculty and university leaders seeking to implement a similar model, we would advise staying attuned to four overlapping principles.

**Effective Leadership and Project Management.** Faculty leadership of a team has a huge impact on team cohesion. Yet, many faculty lack experience in organizing collaborative, interdisciplinary projects. Professors also may struggle to find the time to devote sufficient attention to guiding project-related research. To guide faculty, we have built several design nudges into our proposal process that prompt attention to key issues like regular meetings and deployment of discrete subteams. We have developed an orientation for new team leaders and a robust suite of online team resources to support all faculty leaders—providing templates for team charters and grading rubrics for joint work. We have also encouraged faculty leads to appoint a graduate/professional student to partner with them as a project manager. This step ensures that teams have someone responsible for key organizational matters, such as communicating project goals and timelines; it also provides graduate/professional students with an opportunity to demonstrate leadership and manage a complex project.

**Layered Mentoring.** Most Bass Connections projects include graduate/professional students who play critical roles mentoring undergraduate students. Effective deployment of these more advanced students correlates with positive evaluations from all students, as graduate/professional students benefit from the leadership experience, while undergraduate students gain a “near-peer” who can answer questions about conceptual frameworks, research methods, and modes of communicating findings.

**Open-Ended but Well-Supported Inquiry.** Students benefit greatly from engaging in applied research experiences without pre-determined answers and in which they have a significant voice in shaping research objectives and design. The experience demands that they navigate ambiguity, take an inquiry-based approach, participate in collective decision-making, and engage in teamwork. These interrelated elements represent a shift from

more didactic learning environments and thus require the right framework of support. We often counsel our teams on how to “scaffold” the experience for students, starting with a more structured approach that provides grounding in intellectual context and research methods and then gradually expects students to take greater ownership and initiative.

**Team Structure.** Student satisfaction and effective conduct of research especially depend on clear goal setting and well-designed mechanisms to meet those goals, such as a detailed, adjustable research plan that specifies individual tasks and deadlines. While the size and organizational approaches of project teams vary widely, these fundamentals remain key to team success. Intriguingly, our evaluation efforts have found no correlation between team size and student experience—even though some teams have as few as four students and some as many as twenty!

Some project teams work collectively, while others—especially larger ones—divide into subteams that focus on different questions, specified geographic regions, or distinctive methodological approaches. Often these subteams will be led by a graduate/professional student to reinforce the layered mentoring model. We have found that there is no single answer when it comes to team structure. The key is to ensure that teams furnish clarity around goals, roles, and processes. For the many advantages offered by a subteam model, that structure adds a layer of complexity in ensuring a good flow of communication and integration between streams of work.

To ensure progress and team communications, Bass Connections teams meet at least once a week, with some adding another meeting for subteams. We encourage teams to use planning tools, such as a project charter, a statement of team ground rules, and a project plan, to facilitate these meetings. We also emphasize the importance of using meetings to engage in productive, collaborative dialogue and problem solving, with routine updates circulated asynchronously.

## Discussion

For all of Bass Connections’ many successes, two interrelated obstacles complicate integration of the program into Duke’s curricular structures, each of which would confront other universities seeking to adopt similar models of interdisciplinary, project-based learning.

**Curricula Remain Primarily Framed Around Disciplines.** Although Bass Connections provides academic credit, adoption of this feature faced hurdles. Duke’s general education curriculum for undergraduates requires students to take two courses in five major divisions of knowledge. A typical Bass Connections project, which seeks to integrate insights from multiple disciplines, fits uneasily into this framework.

Take the example of one project team, American Predatory Lending & the Global Financial Crisis, which used a mixed methods approach to explore the causes and implications of the 2008 financial crisis. One subteam analyzed mortgage market data to surface state-level trends about residential house prices, defaults, and foreclosures. Another conducted oral history interviews with state legislators, regulators, community activists, and individuals involved in selling and financing residential housing. Other subteams researched mortgage-related legislation and undertook case studies of financial firms that failed during the crisis. Some students participated in multiple subteams. How, if at all, should these students receive credit for areas of knowledge? The curriculum does not readily accommodate varying engagement with disciplines by different students within a single course.

Similar conundrums bedevil undergraduates on project teams who seek credit toward majors. Although some departments provide credit if the students’ research aligns with their discipline, others view interdisciplinary work as insufficiently grounded in disciplinary epistemology. Graduate and professional students similarly struggle to secure academic credit for interdisciplinary projects, particularly within highly structured professional degree programs such as medicine or law that have exacting accreditation requirements.

**Modes of Accounting for Faculty Time Lack Flexibility.** As we have noted, participating faculty receive project funding and a mechanism to recruit excellent students to support exciting research—but this model blends research and teaching. With few exceptions, faculty leads do not receive teaching credit. Attempts to create crediting options are complicated by the fact that projects span the academic year and generally involve multiple faculty co-leads. About a third of the faculty who lead teams, moreover, come from professional schools without an undergraduate teaching mission. These issues are closely related to the challenges with providing academic credit.

Despite the rising number of university-wide interdisciplinary programs across higher education, curricular structures and faculty lines remain

geared to disciplines and schools. For faculty to embrace innovative programs that reach across disciplines and fuse education, research, and societal engagement, we need more flexible ways of crediting faculty effort. Possible solutions might include the provision of fractional credit or establishing endowed chairs that support faculty teaching across schools. Creative approaches to addressing these two issues will be crucial if we are going to continue scaling up our own program to meet strong student demand.

## Scaling Interdisciplinary, Project-Based Learning

In light of the positive impacts that we have documented for students and faculty who engage with Bass Connections, we see a powerful argument for colleges and universities to explore how they might borrow this integrative approach. That said, we also recognize that the program was able to achieve significant magnitude in just a few short years because of favorable circumstances that may be hard to replicate. The program enjoyed strong support from Duke's president and provost, donor support to launch at scale, and a robust infrastructure and culture supportive of interdisciplinary efforts. If we were going to build our own program anew or attempt to implement it elsewhere with fewer available resources, we would argue for design tweaks to make this model more sustainable and scalable.

Bass Connections has a sufficient endowment to provide each year-long team an average of \$20,000 to cover expenses such as research travel, project manager stipends, laboratory materials, and software licenses. This funding is necessary for global fieldwork or complex lab experiments, but many of our teams, especially those focused on local issues, could operate on a much smaller budget. To scale the model, universities might start by embedding applied, collaborative research endeavors into curricular structures along with mechanisms for assigning teaching credit to faculty leads.

Several universities experimenting in this area have taken this path, although on many campuses these programs tend to have a STEM orientation (Balleisen, 2022). At the [University of Waterloo](#), the Department of Knowledge Integration's undergraduate major requirements include extensive grounding in problem definition, research design, and the dynamics of teamwork, all supplemented by engagement in several collaborative research projects. Several other universities have joined the [Vertically Integrated Pro-](#)

[jects Consortium \(VIP\)](#), led by Georgia Tech. VIP programs coordinate, but do not fund, multi-year, team-based research projects originated by faculty and involving graduate and undergraduate students. Perhaps most notably, since the 1970s [Worcester Polytechnic University](#) has oriented its entire curriculum around project-based learning.

Across the country, humanities and social science labs have mushroomed, many anchored around project-based courses, and some predicated on deep engagement with external partners or clients. For example, for several years [Arizona State's Humanities Lab](#) has probed a rotating set of social issues through humanistic research methods. Universities have also increasingly embraced opportunities for students to engage with pressing issues concerning their own towns, cities, and regions. This approach fosters community-engaged inquiry while limiting the travel costs associated with fieldwork. [Rice University's Houston Action Research Teams](#) and the [Liberal Arts Action Lab](#), a partnership between Capital Community College and Trinity College in Hartford, Connecticut, serve as two models for grounding local research in the curriculum.

The rapid expansion of IT infrastructure to facilitate remote interaction further beckons as a means of conducting more affordable research across regions and continents. Linked teams of students in two cities or countries might each do fieldwork or complementary research in their locality, leading to comparative or other sorts of integrated analysis. Drawing on these strategies, we have had teams work with faculty and students at universities as far away as Brazil, Uganda, and Nepal.

For all the benefits that accrue to students from year-long project teams, the most sustainable and affordable way to increase interdisciplinary, project-based learning surely lies through the mechanism of regularly offered semester-long classes. We see great opportunities to increase the number of what we have coined as “Collaborative Project Courses.” In such classes, student learning occurs through team-based engagement with applied projects that extend across an entire semester. These curricular offerings often reach beyond the classroom, giving students a chance to bring their academic knowledge and skills to bear on complex problems under the mentorship of faculty, graduate students, and, in some cases, community leaders. Collaborative Project Courses are often interdisciplinary and can be taught at any level (from first-year courses to master’s capstones and PhD research seminars).

A few examples suggest the many contexts that can support Collaborative

Project Courses. A recent history course explored the history of Latinx student experiences at Duke, producing an exhibit hosted by the university library. In a public policy course, students worked in small groups, undertaking research related to early childhood policy that informed decision-making at local nonprofits. Most ambitiously, Duke's engineering school now requires all first-year undergraduates to complete a design course in which student groups tackle authentic engineering projects for local clients.

To seed additional courses with this flavor, we have developed a faculty fellows program with Duke's Office of Learning Innovation, which provides guidance, resources, and a cohort experience. We have also developed [an online resource center](#) for faculty, from which we encourage other universities to borrow, and we have created a complementary "[Collaborative Expeditions](#)" [grant mechanism](#) that provides financial support to graduate students who partner with faculty on relevant course design efforts.

Development of new courses takes time and effort. Accordingly, we suggest that universities prioritize the provision of resources to help faculty in this process. Aside from the support we have already mentioned, many faculty require guidance in building durable partnerships with potential external partners, while students who will be undertaking community-engaged research require appropriate training. This latter point requires particular emphasis, since equitable community engagement depends on the ability to listen to and learn from partners, as well as attention to inclusive decision-making (Beyond the Academy, 2022).

Early career faculty who must design new courses stand out as a promising constituency, as do new units or existing ones undertaking curricular revamps. If institutions of higher education wish to accelerate movement in this direction, they might encourage the adoption of experiential learning-related curricular requirements, whether attached to general education expectations or specific majors or certificates. Intriguingly, Emory University has just gone down this path, adopting a new general education requirement framed around courses that expose undergraduates to "experience and application."

## Conclusion

With careful planning, a willingness to reimagine curricular structures and the contexts in which faculty receive teaching credit, and the creation of the right kinds of institutional support, colleges and universities can sustainably bring research-inflected, team-based education to large numbers of their students. Through such investments, exposure to interdisciplinary collaborative projects and related forms of experiential learning can become a core feature of higher education. Such a move would depend on a wider recognition that such experiences complement more traditional frameworks of instruction by preparing students to work in diverse teams, conceptualize wicked problems, and adapt to the evolving demands of our world through creative, interdisciplinary inquiry. It also requires reconfiguring core expectations about the complementary ways that faculty teach and students learn.

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## Appendix: Image Long Descriptions

### Image 1:

The core connections are: Research across areas of disciplinary expertise; Teamwork across learner levels; and Impact between the academy and the world.

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### **Figure 1:**

This infographic of the Bass Connections Impact Model lays out the short-, medium-, and long-term outcomes for faculty and students.

The short-term faculty outcomes are mentoring capacity and exploring new research avenues; medium-term outcomes are community impact and research impact, publications and grants, and networks at Duke and beyond; and long-term outcomes are new approach to pedagogy and new research trajectories.

The short-term student outcomes are finding mentors, teamwork and research skills, clarifying interests, and portfolio pieces; medium-term outcomes are informing thesis/dissertation work and clarifying educational pathways; and the long-term outcome is influencing career trajectories.

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### **Figure 2:**

This flowchart centers the Bass Connections Project Teams and shows how the impacts and results of faculty participation are all connected.

One result is an impact on teaching, which can lead to new courses or new approaches (e.g., team-based, problem-centered). Another result is new faculty collaborations, which can lead to seed grants to explore new research vistas. Preliminary findings from those grants can lead to external funding. New collaborations can also lead to outreach endeavors, which can, in turn, lead to more engaged research.

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# 4. Open Spaces of University Campuses as Living Labs for Urban Sustainable Transformation

## *A Case Study*

CHRISTOPH KUEFFER; IRINA GLANDER; SASCHA A. ISMAIL; MARK KRIEGER; GABI LERCH; AND JASMIN JOSHI

Humanity is faced with many interrelated environmental and social crises including biodiversity loss, depletion of soils, climate change, overexploitation of natural resources and the limits to growth, pollution, pandemics, socio-economic inequalities, poverty, hunger, political instability, and a crisis of democracy, amongst others (IPBES, 2019; United Nations, 2019; von Weizsäcker & Wijkman, 2018). All of these crises are related to an accelerating degradation of the natural capital of the planet as well as to an increasing pressure on diverse local livelihoods and their social and cultural capital. Evidently, technological solutions alone will not suffice to solve these grand challenges, and the current economic system is a major driver of them (Akandil et al., 2021).

The seventeen Sustainable Development Goals, or SDGs (United Nations, n.d.), of the *2030 Agenda for Sustainable Development*, adopted by all United Nations member states in 2015, call for urgent action to tackle these interconnected global crises, which ultimately threaten humanity. While global networking and collective action of the nations of the world are essential, the problems are too big and diverse to be solved through top-down approaches. It is questionable whether the problem-solving strategy characteristic of science-policy approaches of modernity that aims to simplify complex problems by separating the understanding of a problem (systems knowledge) from reaching a consensus on targets (target knowledge) and devising solutions (transformation knowledge) can still work (Kueffer et al., 2019). It might often be unrealistic to achieve a definite clarification of prob-

lem diagnosis, targets, and solutions. Instead, continuous and locally rooted social learning processes might foster cultures of responsibility, empowerment, and agency. Nature-based and social innovations, do-it-yourself technologies, and the reappraisal of vernacular technologies and traditional knowledge might often be a more reliable guide to the future than the hope for disruptive technological breakthroughs (e.g., Kueffer, 2020a).

Living labs are in the sustainability sciences increasingly explored as a promising transdisciplinary research, innovation, and problem-solving strategy to tackle complex, socio-environmental challenges in specific local settings (Hossain et al., 2019). They are conceptually embedded in theoretical insights from science and technology studies, or STS (Gross & Krohn, 2005), and transdisciplinarity scholarship (Jahn & Keil, 2016). Living labs enable experimental co-learning processes involving academics as well as practitioners and stakeholders with the aim to generate robust and systemic solutions in a specific implementation context, but also generalizable insights that are transferable to other cases. In Europe, often the term “real-world laboratory” is used (Schäpke et al., 2018; Kueffer, 2024). The real-world laboratory approach has become an important strategic instrument for science-funding (Defila & Di Giulio, 2020) and for guiding collaborations at the science-policy interface (von Wirth et al., 2019); for instance, in Baden-Wuerttemberg, Germany (Wagner & Miller, 2018; Ministerium für Wissenschaft, Forschung und Kunst Baden-Württemberg, n.d.) or in the city of Zurich (Stadt Zürich, n.d.). The hope is that living labs foster societal transformations toward sustainability (Augenstein et al., 2022; Wagner & Grunwald, 2019). The issues addressed through living lab research are very diverse and include amongst others sustainability on university campuses (Leal Filho et al., 2020; Evans et al., 2015); the design of educational buildings (Kirschbaum & Wacker, 2018); and the creation of outdoor learning environments (Rudow & Bugmann, 2021).

We discuss in this chapter a specific case study of a university campus in Switzerland as a living lab for social learning and innovation at the intersections of ecology, landscape design, and civil society. Specifically, we discuss how the open space of a university situated in an urban environment can serve as a creative space for interactions between students and researchers, between different disciplines, and importantly between academia, practitioners, and the general public. Cities are increasingly seen as innovation hubs for societal transformation toward sustainability (Barber, 2013), and the development of urban transformative capacity is considered a high prior-

ity for research and planning policy (Wolfram et al., 2019). A majority of the world population, meanwhile, lives in cities, and consequently, urban populations are responsible for the bulk of global resource consumption (IRP, 2018). Urban life has long been seen as an incubator of ideas, initiatives, and social and cultural change. What works and what does not work becomes quickly visible in cities. We consider the open green spaces of our university as a real-world laboratory of how a specific urban space can function as such an innovation hub.

Our living lab is part of a university of applied sciences, and thus research and teaching are closely interwoven with practice (Kueffer et al., 2017; Swiss Academies of Arts and Sciences, 2020). We educate students for specific professions and are in constant exchange with professionals. Students mostly work part-time while studying, and professors work—besides teaching and basic research—in applied and transdisciplinary research and as policy consultants. As a technical university, we combine planning, building, and design disciplines with engineering and information technologies, but we also include teaching programs for social work and health professions. These institutional settings integrate our real-world laboratory not only into the urban fabric of the city and the daily life of the region, but they also form regional to national networks bridging between innovation, diverse professions and businesses, civil society, and policymaking at communal, cantonal/county, and national levels.

The living lab is run by a landscape architecture school and more specifically by the ecology and planting design team. As a plant-focused team, we develop inter- and transdisciplinary solutions at the intersections of ecology, nature conservation, and horticulture—for instance, on the potentials of horticulture for *ex-situ* rare species conservation (Ismail et al., 2021). As a landscape architecture school, we educate the designers of green and blue infrastructures and thus can use the open space surrounding the university in a very specific way as research and learning grounds for our own discipline and profession. As ecologists and horticulturalists, we work on bringing ecology back into cities and man-made landscapes by developing nature-based solutions, regenerating degraded ecological systems, designing novel ecologies, and strengthening human-nature relationships (Beatley, 2016; Hes & du Plessis, 2014; Krasny & Tidball, 2015; Kueffer, 2020b; TEEB DE, 2017). In this sense, we understand our living lab as an experimental space for enabling an ecological U-turn in a time of ecosystem degradation, biodiversity loss, and subsequent loss of human-nature interaction (Soga & Gaston,

2016). We build on the long history of landscape architecture in designing spaces that bring humans and other living beings together (Giroto, 2016; Kueffer et al., 2022; Ndubisi, 2014). There is growing literature that demonstrates the great value of urban nature and gardening for fostering learning, enabling sustainability, and contributing to health, life quality, an ethic of sustainability, and social cohesion (Beatley, 2016; Cooper, 2006; Hes & du Plessis, 2014; Krasny & Tidball, 2015; Stuart-Smith, 2020; TEEB DE, 2017).

In the following, we describe our Open Space Living Lab on the Campus Rapperswil-Jona (Switzerland). We start by reviewing the fifty-year history of the campus and then describe the current setup of the open spaces (Glander et al., 2022; Lerch, 2022). Thereafter, we present some of the specific research, teaching, and social learning activities and discuss how they show the potentials of open urban spaces and gardening as societal learning opportunities for tackling challenges such as climate change adaptation, biodiversity loss, and sustainability.

## The Living Laboratory at Campus Rapperswil-Jona (Switzerland)

### The Campus and its History

In 2022, the University of Applied Sciences in Rapperswil celebrated its fiftieth anniversary (Campus Rapperswil, OST Ostschweizer Fachhochschule, formerly HSR Rapperswil [OST Rapperswil, n.d.]). The campus complex of low pavilion buildings on an open green space next to the lake of Zurich was built in 1972 and modeled after American universities (Joshi et al., 2022; Lerch, 2022). The intention of the architectural and landscape design was to make the site's tension perceptible: the tension between the partially protected lakeside landscape with its old trees and remaining fens and reeds against the medieval old town surrounded by more recent urban developments, which is separated from the site by the tracks of the Rapperswil train station (Krieger et al., 2022). In 1999 and 2015, new buildings were constructed on the site while maintaining the open character of the campus landscape. There are now around six hundred employees and fifteen hundred students sharing the 30,000 m<sup>2</sup> campus park between the lake and the

city with the public. Thanks to the promotion of biodiversity, in 2020 the campus was awarded the quality label of a [Swiss foundation](#) devoted to promoting biodiverse green spaces on public and private land (figure 1).



**Figure 1:** On the OST Campus in Rapperswil-Jona, substantial space is reserved for nature. A large meadow in the center of the campus and in front of the university's main food court serves as a demonstration object of the effects of microtopographic and abiotic variation on vegetation patterns and biodiversity. A dry-to-wet gradient that ranges from the dry hill on the left to the regularly inundated depression on the right was deliberately designed.

## Planting Designs

The concept of the plantings stages the location between the nature reserve near the lake and the town of Rapperswil (Joshi et al., 2022; Krieger et al., 2022). Toward the lake, native species dominate the plant selection. There is a wild plant garden with native species typical of the site, but also a selection of drought-tolerant “climate change” plants from the Valais—a Swiss inner alpine valley characterized by a continental, dry climate—and a selection of alpine plants. In addition, there are various habitats for wild bees, deadwood structures to enhance fungal and insect diversity and soil formation, a flowering lawn—“Tapestry Lawn” (Ignatieva, 2017; Smith & Fellowes, 2013)—and a species-rich meadow that ranges from fen vegetation to dry calcareous grassland thanks to designed micro-topographical variation (figure 1). Various rare, native plant species have established here spontaneously. Toward the city, ornamental plants from around the world increasingly dominate. In the last five years, the basic structure of the campus has been revitalized with a total of more than 350 newly planted woody plants,

nine thousand new and five thousand replanted perennials and sixteen thousand bulbs and tubers. Within these plantings, drought-tolerant trees have been introduced, which may be resilient to the changing climatic conditions. Native and nonnative perennials are planted in mixed plantings designed based on ecological principles (figure 2): species and ecotypes are fitted to the particular ecological conditions of the microsite (e.g., light, soil, microclimate, topography) and combined according to life history traits (e.g., ruderals, competitors, stress-tolerators, guerilla- versus phalanx-growth of clonal plants or complementarity of root systems; Hitchmough, 2017). Perennial plantings are dynamic; especially under the influence of hotter and drier summers, changes in the composition are allowed and observed. The collection of plants from around the world is meant to showcase the wonders of global biodiversity, to contribute to its conservation as *ex-situ* collection (Ismail et al., 2021), and to promote a diversification of plant uses in horticulture to make gardens and urban green more resilient (age-structural, genetic, ecotype, and species diversity).



**Figure 2:** Mixed plantings of native and ornamental plants are modeled after natural vegetation types and fitted to the different environmental conditions, e.g., a combination of annuals, perennials, and woody species in a shaded habitat. In total over one thousand different plant species can be found on the campus.

## The Campus as a Living Lab



**Figure 3:** Throughout the year, the aesthetic appearance of the plantings changes, for instance thanks to colorful leaves in autumn. Changing seasons, the effects of extreme climate events such as a drought period or heavy rainfall, and the efforts needed to care for the green spaces can be observed on a daily basis directly in front of the working and teaching environment.

Based on the evolved qualities of the outdoor space as a plant collection and public meeting place, we use the campus as a so-called “Freiraumlabor” (Open Space Living Lab) for teaching, applied research, and outreach (Glander et al., 2022; Krieger et al., 2022). Students have the opportunity to discover numerous labeled ornamental and wild plants. They experience the day-to-day changes in plantings and thus learn about the practical challenges of caring for them (figure 3). For instance, we trimmed the branches of an old willow tree instead of felling it, thereby ensuring that there are no hazard risks while keeping an attractive landscape feature on the campus. More generally, we integrate deadwood from fallen and cut branches and uprooted trees in the evolving design of the campus. An alley of birch trees is currently dying due to the age of the trees but also due to droughts and other negative human influences. We left the uprooted rootstocks or the remains of the dead but still standing trees in the places where the trees grew as a habitat for invertebrates and as a memorial for the trees, and we moved the cutoff deadwood—or even the complete stem of the dead

tree—to different locations on the campus where they can, for instance, be used as informal benches (figure 4). For research, we test new international developments such as urban microforests (“Miyawaki Forests,” figure 4) and grass-free, multi-colored flowering lawns beneficial for insect pollinators (“Tapestry Lawns”).



**Figure 4:** In a 10×10 meter area we planted seven tree individuals per square meter from more than twenty species to create a tiny forest (“Miyawaki forest”). The stem of a birch tree that was uprooted on the campus by a storm was integrated into the design. The topsoil was removed and used to create an artificial hill in the middle of the forest (top right photograph taken by a drone, courtesy of Paul Haverkamp, VegeEye Lab, OST Rapperswil). The public, including children, were involved in the initial planting (top left photograph).

The Open Space Living Lab also enables the promotion of wild animal species in urban areas by applying so-called animal-aided designs (Apfelbeck et al., 2020). For example, Common Terns (*Sterna hirundo*) and Black-headed Gulls (*Larus ridibundus*) have been successfully established on the flat roof of the OST Rapperswil administration building after using recorded bird voices to signal this space as a putative breeding ground, and the public can observe them [via a webcam](#). A highly visible wild bee hotel with an information board is located in the immediate vicinity of the outdoor cafeteria area and adjacent to a tapestry lawn. It is important to us that the Open Space Living Lab provides opportunities for public exchange—for instance through science-art projects like the interactive experiment “Climate Garden 2085”

(Schläpfer-Miller & Dahinden, 2017; Schläpfer-Miller et al., 2023; Klimagarten, n.d.), which we carried out in 2019 with the artist Juanita Schläpfer-Miller. Two greenhouses formed the core of the installation: one heated to 28°C, the best-case scenario of the average summer temperature in 2085, and the other heated to 31°C, the climate to be expected if current CO<sub>2</sub> emissions continue ([figure 5](#)). Native wild plants from alpine and lowland areas as well as crops—for example, wheat, corn, soybeans, buckwheat, peanuts, and the dwarf millet *Eragrostis tef*—were grown in both greenhouses. Visitors of the public exhibition were able to observe how the climate might affect plants familiar to them, from the field to the kitchen, and experience the difference of the effect on crops from arid and subtropical versus temperate areas. The art project was accompanied by events such as a public lecture series and art workshops with plants (Schläpfer-Miller & Dahinden, 2017).



**Figure 5:** The art-science public intervention project “Climate Garden 2085” allowed us to observe the response of various plant species to different climate conditions in two greenhouses (upper photograph). Food and ornamental plants familiar to the general public were grown in the greenhouses (lower left photograph). A series of workshops and lectures accompanied the installation (lower right photograph).

Much of our teaching in ecology and plant use takes place outdoors on the campus. During the time of the COVID-19 pandemic, when indoor classes were almost impossible, the campus became our main classroom. We collect plants and study their stomata under the microscope, observe birds and their ecological interactions, discuss drainage systems hidden in the soil, discover features typical of healthy soils, and develop small landscape architecture projects from planning to implementation. For instance, we have planted drought-adapted as well as fruit trees together with students. Behind our wild plant garden, we have established our own compost system, trying to combine function with design. Further, students are responsible for

a recreation area surrounded by raised beds in front of the landscape architecture program building.



**Figure 6:** In the teaching module on sustainability of the bachelor program in landscape architecture, student teams imagine positive futures of the university campus. This visualization includes some of the often addressed themes of many student teams: social appropriation of open spaces, enabling communication and cooperation between institutes and students from different disciplines, unsealing sealed surfaces and climate adaptation, green facades and roofs, renewable energy, human-nature and human-animal relationships, and urban gardening and farming (student team: Julia Bieri, Alexandra Held, Corina Niederberger, Dominika Sovcikova).

In classes about sustainability, students learn to connect different perspectives of campus users and develop visions for the future (figure 6; Kueffer et al., 2022). To do this, they try out, for example, the “inventive analysis”—a method developed in the late 1980s by the French artist and landscape architect Bernard Lassus, b. 1929 (Koenecke et al., 2010; Lassus, 1998; [figure 7](#)). Through different artistic and creative strategies staged within the open space, designers, and, in our case, students attempt to disturb, broaden, and enrich their perceptions of the characteristics and potentials of a location with the aim of discovering new possibilities for the development, uses, and designs of the space. Broadening inventive space in the analysis phase of a design process should help to transgress lock-in situations and reach novel solutions. This method demonstrates how experiential activities in a living lab can invite critical reflection—especially also

about the invisible aspects of design such as ownership and regulations, power relationships, social codes, everyday routines, and symbolic meanings inscribed in a particular urban space (Burckhardt, 2015; Lefebvre, 1991; de Certeau, 1984). An important aspect of our living lab in this context is that it overlaps with the everyday lifeworld of the participating students and lecturers. From the new insights gained from these explorations, the students develop their visionary concepts and ideas for specific interventions on and future designs and uses of the campus (figure 8).



**Figure 7:** The “inventive analysis”—a method developed by the French artist and landscape architect Bernard Lassus—invites students to discover the open spaces of their university in new ways through different artistic and creative strategies. The lack of opportunities for students to appropriate the open spaces of the university campus was a recurrent theme. This team installed an informal recreational space in front of the main entrance of the administration building of the university (student team: Lukas Ahmadi, Sanghamitra Dhar, Theo Hagen, Ayo Merz).

Further, based on texts by the famous German garden architect Leberecht Migge (1881–1935; Gadiet et al., 2018)—whose plans are mainly archived and curated in the [Swiss Landscape Architecture Archive](#) at our university—students are innovating ways to integrate food production as well as a circular economy on the campus. Migge was an important representative of the life reform movement of the early twentieth century, when urban and small-

scale gardening was fashionable in European cities more than one hundred years ago as a way to alleviate food shortages (Lerch & von Schwerin, 2017). Hence, the living lab on the campus allows for hands-on experiences of the history of garden culture. We critically discuss with our students past and current visionary thinking while experiencing in a real-world setting what they might encompass and what the specific and tangible challenges and benefits might be. Importantly, the actual design solutions of the students are put in relation to other ecological design projects that they engage with during their studies on the campus, especially with horticultural aspects. Thereby we link reflection on social transformation of urban spaces with rich and specific ecological thinking and the concrete experience of gardening and caring for a planted space. We believe that a garden, in this broad sense, can be a heterotopic site *sensu* Michel Foucault (Foucault, 1984) that allows us to link the past to the future but in novel and subversive ways. And we believe that gardening as an individual and social activity invites the nurturing of virtues such as cooperation, humility, responsibility, biophilic sensibilities, or care (Stuart-Smith, 2020; Krasny & Tidball, 2015; Cooper, 2006).



**Figure 8:** Broadening inventive space through the “inventive analysis” method should help to transgress lock-in situations and reach novel solutions. The picture on the left shows the inventive analysis of a student team that placed pockets of vegetation on a large sealed surface from which plants and trees start to grow in the form of children’s drawings. The right picture shows the visualization of a possible future open space that developed from this intervention (Student team: Luana Federer, Noémie Stalder, Zora Zweifel).

## Discussion

We have now been developing our Living Lab in the outdoor space of our university for several years, and both some challenges and opportunities have become apparent. A crucial design principle for the success of our living lab is that we are building it on a specific and well-chosen conceptual backbone while allowing for great interdisciplinarity and open-ended processes. This chapter explains in particular the underlying conceptual vision of our living lab: developing gardening—understood in a broad sense—as a sustainability practice that cares for green urban spaces and thereby contributes to transformative social processes toward sustainability. This vision is well-chosen because it fits to our specific geographic space, to our focal disciplines and professions, and to key aspects of sustainable transformations: public green spaces and urban sustainability. Thanks to such a clear overall focus, we can communicate the integrative character of our living lab despite its diversity and evolving nature, demonstrate its positive outcomes through tangible improvements of the urban open spaces on the university campus, and legitimate it as a pivotal tool for teaching and research at the university. Importantly, such a conceptual core does not constrain but rather fosters open-endedness and interdisciplinarity (compare the boundary object concept; Opdam et al., 2015; Star & Griesemer, 1989). For instance, the student projects on the campus emphasized, in particular, the demand for social appropriation of public spaces (figures 6 and 7)—a demand that can be in contradiction to the promotion of biodiversity and ecosystem services. Through this tension we ended up exploring questions of social and cultural sustainability in connection with the dimension of ecological sustainability. More generally, through growing interests in our living lab, we are increasingly confronted with ideas of other disciplines such as architecture or engineering on how to further develop the campus as a living lab. This forces us to think about the intersections, and possible synergies, between interventions and infrastructures in urban spaces that are not necessarily easy to reconcile.

A major opportunity of our living lab is that because of the proximity and the familiarity of these spaces amidst our daily working environment, innovative inter- and transdisciplinary teaching and research ideas can often be implemented easily, quickly, and in an informal way by using synergies and fitting activities into existing budgets and teaching formats. For instance,

while sitting during a coffee break under the plane trees in front of the cafeteria ([figure 1](#)) with a colleague from another institute, a part of nature in front of our eyes on the campus might trigger a discussion, and this might directly lead to a small activity that otherwise might never have happened.

We have for instance organized a public event on climate-friendly living on the campus with the [climate and energy competence center of our university](#) and within the scope of the energy transition strategy of the regional government (canton of St. Gallen). The outdoor classrooms during the COVID-19 pandemic are a particularly telling example of pragmatically using such opportunities. It sufficed to organize a couple of chairs and tables, store them in an outdoor rain shed location, and start teaching ecology outdoors, whether it was sunny or rainy.

Such informal processes, however, also contribute to a major challenge: they do not fit with the existing budgets of university administration. Maintaining an ambitious urban green space full of native and ornamental plant biodiversity and nature-based learning opportunities requires a lot of planning and maintenance work that is financed neither through teaching nor facility management budgets. Therefore, at present, maintenance of our living lab is mostly done voluntarily and is not paid for. The hope is that the living lab as a key infrastructure of our university and as an innovative teaching as well as research and development approach will gain further recognition and will get a budget in the future. In the Swiss academic world, the living lab approach is currently gaining momentum as a strategic priority, which will help to further develop [such models](#).

More generally, establishing living labs and other forms of outdoor learning experiences has become a major focus of interest at universities as well as other types of schools but also, amongst others, at museums and as part of participatory processes and interventions by city administration. There are, thus, increasingly opportunities for networking at local, regional, and global scales. In Europe, there exists, for instance, a [Real World Lab network](#), a growing [network of biodiversity campuses](#), and there are numerous global networks of local learning initiatives, including the [Global RCE Network for Education for Sustainable Development](#) coordinated by the United Nations University. We try to engage with other living labs through such networks, although, due to time constraints, this is often not possible to the extent we would wish. However, collaborations do happen. In the spring term of 2023, we taught a design studio as part of a living lab focused on circular economy in the city of Zurich run by [RCE Zurich](#).

Our living lab is meant to create a tangible and archetypal space for exploring much broader issues of a societal transformation toward a sustainable future in a participatory and context-sensitive way. The current societal crises force us to rethink what scientific innovations are and which role academic institutions should play in society. We need to find strategies that help us as individuals and societies to free ourselves from psychological, social, cultural, and economic constraints that lock us into destructive pathways of societal development. The political philosopher Hannah Arendt attempted to show how humans as creative and cooperative beings always have the capability to work against prevailing developments and teleological narratives of the future through free action that leads to natality—the miracle of new beginnings (Arendt, 1958). Arendt’s hopes focused on the public spheres of discourses, democratic deliberations, changing narratives, and resulting cooperative action. Sustainability science builds heavily on participatory processes, and with this on the trust in democratic deliberations of political philosophers such as Hannah Arendt or Jürgen Habermas.

New developments within the cultural sciences, such as the environmental humanities, emphasize the importance of narratives and other cultural forms of shared orientation and meaning for a societal transformation. However, increasingly, life in unprivileged as well as affluent social contexts is confronted daily with environmental limits and, thus, the natural laws of the material world. Our health depends on easy access to high-quality outdoor spaces, clean air and water, the ecosystem services of healthy ecosystems, and a functioning climate. Reproduction of life itself becomes by necessity a public not just private issue (von Redecker, 2020). And we also realize that we can only change the economic system if we rethink work—the process of making things—as craftsmanship that is faithful to an ethics of skillful work and fairness in the interest of the common good (Sennett, 2008). In short, knowledge production must find ways to enable novelty simultaneously along the three dimensions of (1) the labor of existence as biological being within the web of nature; (2) work as responsible craftsmanship and meaningful and socially fair activity; and (3) action through speech, narratives, reconnection to myths, interweaving of cultural traditions, and social and cultural cooperation (e.g., Salami, 2020).

The modern sciences work by bounding the complexity of physical realities in constrained settings such as a laboratory that allow for trial-and-error learning processes. A living lab can be seen as such a laboratory setting that allows us to simultaneously address the three dimensions of labor—exis-

tence, work, and speech—with the aim to enable a radical restructuring of social, economic, and environmental systemic interdependences. A living lab, thus, has to be specific but generalizable in terms of (1) work and craftsmanship, (2) living within environmental boundaries, and (3) cultural and social change. In the case of our living lab, plants, green spaces, and urban life intersect. Thus, we bring together the craftsmanship of gardening and horticulture, the biological conditions of urban life—including the health effects of urban green on humans—and the sociocultural space of an agora where the public, academics, and students can meet. Our Open Space Living Lab is, thus, conceptually an attempt at making the idea of cities as innovation hubs for sustainable transformation tangible for new forms of knowledge production and consumption in the context of urban greening and civic ecology (Krasny & Tidball, 2015).

## Conclusion

Our Open Space Living Lab is, for us, an inspiration, but also an invitation for (self-) critical thinking. Above all, it is a way of being—as educators, researchers, and citizens—normative and political in a reflexive and evidence-based way. Developing a biodiverse and accessible urban green space lets us experience that the cultivation of gardens is at the origin of culture (Cooper, 2006; Harrison, 2008; Girot, 2016; Stuart-Smith, 2020). Gardens and plants have accompanied us since time immemorial and are a central component of functioning urban areas. In this time and age of globally interrelated complex environmental crises, the ecological and inclusive design of open spaces can reconnect us to the origins of culture. Our Open Space Living Lab provides an experimental field for creating desirable urban environments where people and biodiversity can thrive. Biodiverse and attractive open spaces can make people happier and healthier, giving rise to alternative notions of quality of life not defined by high consumption. Providing ecologically high-quality urban green space to the majority of people in the world can thus play a key role in the necessary transformative change.

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# 5. University of California Los Angeles (UCLA) Sustainable LA Grand Challenge Undergraduate Research Scholars Program

*Preparing the Next Generation of Transdisciplinary Leaders*

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Transdisciplinary training at the undergraduate level is needed to address complex societal challenges such as urban sustainability (Barth, 2014; Schrot et al., 2020). Although some progress has been made to educate across disciplines, institutional barriers persist that create challenges to the meaningful integration of arts and humanities with sciences, engineering, policy, and medicine (Skorton & Bear, 2018). On a campus like the University of California, Los Angeles (UCLA), some of these barriers are not just organizational, but physical. That is, the arts, humanities, social sciences, and law and policy units are located on “north campus” and engineering, natural and physical sciences, and medicine located on “south campus.” This traditionally siloed approach to education impedes new and innovative cross-disciplinary ideas, whereas these are exactly the ideas needed to address socially complex and multifaceted challenges like urban sustainability, climate change, and environmental justice.

In 2013, then United States President Barack Obama called upon universities, companies, foundations, and philanthropists to join him in the pursuit of Grand Challenges—ambitious and daring goals aimed at solving society’s greatest problems. In response, UCLA’s Chancellor Gene Block announced the first UCLA Grand Challenge in that same year: “Thriving in a Hotter Los Angeles.” This university-led Grand Challenge has since evolved its scope and mission, and today UCLA’s Sustainable LA Grand Challenge (SLAGC) is an interdisciplinary, university-wide initiative aimed at applying UCLA

research, expertise, and education to help transform Los Angeles into the world's most sustainable megacity by 2050—making it the most livable, equitable, resilient, clean, and healthy megacity, and an example for the world. The SLAGC was created in part to break down institutional barriers and harness the unique approaches from all disciplines to address the sustainability of energy, water, ecosystems, and human health in Los Angeles County and in major urban centers across the globe (see Popowitz & Dorgelo, 2018).

The SLAGC Undergraduate Research Scholars Program (URSP) was one of the first programmatic strategies designed through the SLAGC to address urban sustainability, which we define as the integration of environmental health, social equity, and economic vitality in order to support livable, equitable, resilient, clean, and healthy cities for this generation and generations to come. The SLAGC URSP was designed to overcome disciplinary segregation—to excite UCLA undergraduate students early in their undergraduate tenure about opportunities in shaping future urban landscapes by exposing them to the research and approaches necessary to overcome complex sustainability problems. Since its inception in 2014, the program has also worked to evaluate student outcomes and made several adjustments to meet the changing needs of its multiple stakeholders—a vital process as socio-cultural contexts evolve (Lattuca & Stark, 2011). The urban sustainability challenges tackled in the program are the result of a cross-sector effort including UCLA-led initiatives, internal stakeholders, and strategic partners to co-determine urban sustainability challenges in the LA region and to achieve 100 percent renewable energy, 100 percent locally sourced water, and enhanced ecosystem and human health for Los Angeles County by 2050. In this program, second- and third-year undergraduate students from all disciplines or majors are targeted to participate in an academic-year-long curriculum that exposes students to urban sustainability challenges and careers, trains them in the transdisciplinary research approaches used to overcome these complex problems, and unites them in collaborative urban sustainability research. The SLAGC URSP was designed to target undergraduates early enough in the progression of their education to build confidence through skill-building and experience, to uncover potential for research talent, and to begin to establish connections with people in their professional communities (Shaw et al., 2013). Early intervention also provides the possibility of continued undergraduate research experiences once the program is completed that support their retention and further training (review by Sadler & McKinney, 2010; Hernandez et al., 2018).

This chapter documents the design and outcomes from the first five years of the SLAGC URSP, as it embodies UCLA's mission to apply knowledge for the betterment of our global society and the more specific SLAGC mission of applying UCLA's research, expertise, and education to transforming Los Angeles into the world's most sustainable megacity by 2050. The following sections provide: (1) a program description including an overview of the program design and the cooperative, experiential, and integrative learning and peer-teaching pedagogical approaches and (2) an assessment of outcomes that is based on an alumni survey on the student experience, including skill development and evaluation of mentorship.

## Program Description and Evaluation

The SLAGC URSP was created with the aim of offering robust mentorship to undergraduate students—enabling them to enhance their professional and career skills—while fostering a network and community of learning focused on urban sustainability. Further, it was designed to target a student population inclusive of all undergraduates across majors and to support diversity and historically underrepresented students in sustainability. Students are recruited broadly from all disciplines on the UCLA campus, including the Schools of Arts and Architecture; Engineering and Applied Science; Public Affairs; the School of Theater, Film, and Television; and the College, which includes Divisions of Humanities, Life Sciences, Physical Sciences, and Social Sciences. Most students find the program through emails shared by departmental academic counselors or through advertising on their UCLA homepage, but a large proportion of applicants also find the program through the recommendations of past participants. Intentionally inclusive strategies are used to recruit students from diverse backgrounds and groups that have been traditionally marginalized. This includes recruitment from the UCLA Academic Advancement Program, which serves students who have been historically underrepresented in higher education. We also target transfer students who are often excluded from research opportunities because of their limited time on our campus while completing their degree. Further, the application process has evolved to include an essay in which students reflect on how they would add to the diversity of the program.

## Program Components

The SLAGC URSP has three components: (1) faculty-mentored independent research experience, (2) stakeholder-centered group work, and (3) weekly classroom meetings to develop collaborative research and professional skills and to explore urban sustainability careers, topics, and research. These experiences occur during one academic year, consisting of three quarters. During each quarter, students enroll in a two-unit course with the course instructor and pursue an additional two units of independent research under the guidance of a faculty mentor. The specific objectives and curricular design comprising these three components and four units per quarter are described in the following paragraphs.

SLAGC URSP is committed to a strong experiential approach to learning. To join the program, each undergraduate student must be accepted to work with a UCLA faculty member on an individual research project that addresses a problem within the field of urban sustainability. Prospective students are individually guided in the process of researching possible faculty members and their areas of research, followed by making contact and discussing possible projects with faculty in a professional manner. It is worth noting that any faculty member at UCLA whose research addresses sustainability has the opportunity to be involved in the program, and as such, there is no need to recruit faculty into the program. However, faculty who have not previously participated in the program are provided program details and expectations for the student, faculty mentor, and instruction team. If both parties find mutual interests and agreeable expectations, the student and faculty member commit to an academic-year-long collaboration and regular one-on-one interactions. The agreement often involves inclusion in a larger research group and direct supervision by an additional mentor such as a senior researcher, a postdoctoral scholar, or a senior graduate student. Over the first academic quarter, students design their individual research project and write a literature review and proposal. During the following quarter, they receive extensive feedback as they collect and refine their data and work on oral and written communication skills. During the final quarter, students continue to receive feedback and support as they revise the products of their individual research. That work includes presentation both as a final manuscript and as a poster or an oral presentation during the annual UCLA

Undergraduate Research and Creativity Showcase (University of California, Los Angeles, 2022).

To supplement the individual research component and provide students with a hands-on transdisciplinary research experience, SLAGC URSP students address an urban sustainability problem by working collaboratively on a stakeholder-centered group project. This group work is integrative; students share and apply concepts learned from their disciplinary majors and from their individual research experiences to the group projects. Over the years that the program has been offered, this group work has expanded to support the mission and needs of local community stakeholders. Prospective stakeholders and broad topics are developed prior to the academic year, and each student chooses the urban sustainability issue that aligns with their interests during the first academic quarter. Groups are then guided in working with stakeholders to co-develop the specific and achievable research objectives and approaches to address that problem.

Guidance is supplied in part by peer mentorship through an associated leadership program for SLAGC URSP “Project Consultants.” Project Consultants are senior undergraduate students who apply separately to the URSP and already have research experience or who are SLAGC URSP alumni. The Project Consultants are trained in mentorship and project management in the fall quarter and throughout the program through a separate curriculum and weekly leadership meeting. During the second and final quarters, cooperative work is emphasized; student groups regularly meet both inside and outside of class and consult with stakeholders as they collect and analyze data and develop deliverables and/or recommendations to complete their group projects. At the conclusion of the academic year, student groups present their project outcomes in a public forum featured in the annual UCLA Undergraduate Research and Creativity Showcase.

Weekly two-hour classroom meetings have multiple objectives, including developing familiarity with the research setting and process across disciplines, development of professional skills, and exposure to transdisciplinary sustainability research, topics, careers, and professionals. Further, weekly meetings support peer learning and foster community building among students and the sustainability professional guests. During the first academic quarter, students are introduced to Los Angeles-based sustainability initiatives on campus and other local and governmental sustainability offices (e.g., guests from the cities of Los Angeles and Santa Monica that have strong sustainability offices). Learning modules address how to thrive in the research

setting and the development of research skills, including how to conduct a literature search, critically evaluate and interpret the primary research literature, generate research questions, and write a research proposal. The second academic quarter focuses on teamwork skills, data management and visualization, and written communication of research and creative work. The final academic quarter of the program emphasizes integrating new information into a broader context, interpretation of results, presentation of results and graphic design, and the oral and written communication of research.

Throughout the program, metacognition and community and peer learning are supported; students reflect upon experiences and share their skills and thoughts with peers from diverse disciplines. Through quarterly evaluations and surveys, students are asked to provide feedback on how the format and content of the program supports their learning so that adjustments can be made to meet student needs. For instance, at student request, additional modules were developed to address eco-anxiety and resumes, as well as an alumni panel addressing best practices for group projects. Further, students often request guests with specific fields of research interest. Finally, as part of the weekly meetings, UCLA faculty and guest professionals from the Los Angeles region expose students to sustainability-related research and topics—a variety of strategies used to solve complex problems and careers associated with the field of sustainability. This academic-year-long immersive learning experience seeks to provide students with hands-on transdisciplinary research and collaboration skills that they will then be able to apply to future career opportunities.

As mentoring is an essential part of the research experience (Linn et al., 2015), the SLAGC URSP was designed to incorporate tiered mentoring. An instructor interacts directly with students for the full year; they lead the program and weekly meetings throughout to make connections across the program components. In recent years, we added a teaching assistant to increase interaction and feedback and expand perspectives and disciplinary expertise of the teaching team. Each student also interacts with the individual research project faculty mentor at a minimum. As mentioned, there is often a senior direct mentor within the faculty research group as well as interactions with additional role models, mentors, and peer-collaborations within that research setting. Finally, there is an important role of additional mentorship by the peer Project Consultants, as discussed above. Students are guided in observing the research environment and process, taking advan-

tage of interactions with senior researchers, mentors, and stakeholders during their experience and in reflecting on this process.

## Methods: Evaluation of the SLAGC URSP

Creating a program with multiple, integrative components that allow students to have several avenues of development in understanding and addressing Grand Challenge problems like urban sustainability is complex in its nature. Therefore, it was essential to evaluate the extent to which the SLAGC URSP successfully fulfilled its objectives of delivering effective mentorship, cultivating sustainability-focused professional skills, and supporting trans-disciplinary learning outcomes. As such, an alumni survey was designed to obtain feedback about the student experience during the program and to assess what successfully and unsuccessfully supported their learning, skill development, and career goals. The assessment was made possible through a UCLA Instructional Improvement Grant, which provided the time and expertise of education assessment professionals (and study authors) to work collaboratively with SLAGC educators to design and analyze the alumni survey.

The first section of the alumni survey cataloged the respondents' graduating degrees and experiences in research, academia, and on the job market since graduating. It further asked the respondents to describe any further research experiences after their completion of the program. To address their persistence in the field of sustainability, respondents were asked about their most recent job title, employer, and industry. Finally, respondents were asked what, if any, postgraduate degree(s) they acquired or were currently pursuing.

Aligned with the goals of the program, much of the survey was designed to assess self-perceived skill development, career development, fostering of a sustainability community, and mentoring. To this end, close-ended, quantitative questions (using Likert scales) addressed (1) perceived skill development in personal, research, and teamwork areas; (2) perceived program importance for career development; (3) the development of a sense of connection to classmates and the Los Angeles community; and (4) feedback regarding the instructor and their individual research faculty mentor. An open-ended question assessed how students felt about the intersection of the three program components: faculty-mentored individual research,

stakeholder-based collaborative projects, and weekly classroom meetings. Specifically, alumni were asked to describe how the three components of the program complemented each other and if there were any benefits to experiencing the program components at the same time. Finally, an open-ended question asked alumni for suggestions for program improvement or any other comments about the program.

The survey was administered in online format and distributed in October 2020 through our alumni LinkedIn group page and via email; students can keep their university emails for life. Possible risks and benefits were disclosed and confidentiality was ensured, and the project was approved by the UCLA Institutional Research Board. Reminders were sent after one week and after three months had elapsed. The data collection period lasted for four months, concluding in February 2021. Responses to the two open-ended questions were analyzed through exploratory coding to identify themes followed by selective coding of the most common themes and sub-themes, when relevant.

## Outcomes

### Part I: Alumni Demographics and Post-Program Endeavors

The alumni survey was sent to 122 SLAGC URSP alumni (both students and Project Consultants) from five academic years (2014–2019), and a total of forty-nine unique responses were received. The demographic breakdown of the SLAGC URSP respondents was a fair reflection of students in the program with respect to majors. The respondents graduated with majors in environmental science (eleven), geography (ten), engineering (ten), physical sciences (eight), biological sciences (seven), social sciences (five), and the humanities (five); seven respondents received dual majors.

After completing the SLAGC URSP, 30 percent (13/44) of respondents continued with the same faculty-led research group as during their tenure in the program; 52 percent (23/44) worked with a different research group at UCLA; and 14 percent (6/44) participated in research through an institution outside of UCLA. Eleven percent (5/44) of students did not further partici-

pate in a faculty-led research group during their undergraduate education. Of those who responded to a question regarding higher education in a post-graduate program, 37 percent (15/41) enrolled in a master's program; 10 percent (4/41) enrolled in a doctoral program; and 5 percent (2/41) enrolled in a health professional program. Finally, a sustainability-related job position or academic status was held by 51 percent (25/49) of respondents at the time of the survey; several additional students were pursuing higher degrees in medical health, chemistry, or physics, which were not considered sustainability-related for this conservative analysis. Thirty-three percent (16/49) of respondents reported being employed by companies directly related to sustainability, not including academic or governmental positions.

## Part II: Skill Development

The alumni survey evaluated perceived effectiveness of the SLAGC URSP in developing learning, skills, and career networks. Alumni respondents noted significant increases in both personal and professional (research, teamwork, and networking) skills through the program. No respondents noted strong disagreements with any of the assessed personal, research, and teamwork skills. Respondents noted improvement (the majority agreed or strongly agreed) in all six personal skills: time management, intellectual curiosity, decision-making ability, independent problem-solving ability, interdisciplinary mindset to approaching problems, and understanding urban sustainability challenges. Of these skills, a majority of respondents strongly agreed that they had developed the ability to approach problems with an interdisciplinary mindset (57 percent or 28/49) and increased their understanding of urban sustainability challenges (63 percent or 31/49).

All respondents also noted high skill development in terms of research-related skills. The six research-related skills were as follows: ability to find relevant references; ability to evaluate scholarly findings; ability to collect relevant data; ability to analyze data; written communication skills; and verbal communication skills. The ability to analyze data had the highest number of respondents reporting "agree" (63 percent or 31/49), whereas the measurement of written (51 percent or 25/49) and verbal communication skills (53 percent or 26/49) had the highest number of respondents who reported "strongly agree." Among these categories, ability to evaluate scholarly find-

ings had the highest number of respondents who expressed “disagree,” with 14 percent (7/49) of respondents.

The majority of respondents agreed or strongly agreed with five measures of teamwork skills: ability to solve problems as a team; comfort working in groups; interpersonal communication; ability to resolve conflict; and leadership skills. Three of the teamwork-related measurements that received a majority of “strongly agree” responses were as follows: (1) ability to solve problems as a team (57 percent or 28/49); (2) comfort working in groups (69 percent or 34/49); and (3) interpersonal skills (59 percent or 29/49). The majority agreed or strongly agreed on the development of the last two measures: the ability to resolve conflict (59 percent or 29/49) and leadership skills (59 percent or 29/49). Additional comments from the open-ended question concerning the integration of the three program components (individual research, group project, and classroom meetings) also suggest significant development of teamwork skills through the program.

### **Part III: Building Social Capital through Instructors and Faculty Mentors**

High instructor satisfaction was apparent from questions on a four-point Likert scale regarding whether or not the URSP instructor taught skills that helped alumni succeed in jobs or graduate and/or professional school. All but one respondent agreed that their instructor taught skills that helped them to succeed in jobs (98 percent or 48/49), with 59 percent (29/49) who agreed and 39 percent (19/49) who strongly agreed. Respondents unanimously agreed that their instructor taught skills that were applicable to succeeding in graduate and/or professional school, with 51 percent (24/47) of respondents agreeing and 49 percent (23/47) of respondents strongly agreeing. Further, responses to an open-ended question that inquired about any comments alumni had about the program frequently included instructor praise. The extent to which individual project faculty mentors taught skills to succeed in jobs and graduate and/or professional school was also assessed. Whereas a majority of respondents reported that their faculty mentor did teach skills to succeed in both future endeavors (jobs: 73 percent or 36/49; and graduate/professional school: 76 percent or 37/49), a quarter of respondents did not perceive that their faculty mentor taught skills to succeed in

either their job (22 percent or 11/49) or graduate/professional school (16 percent or 8/49). Further evaluation may be helpful to assess if these skills were acquired from other research group members or if faculty mentor-related skills are correlated to other factors, such as certain disciplines.

## Part IV: Program Integration

A key feature of the SLAGC URSP is the simultaneous participation and integration of transdisciplinary group work, independent research, and the classroom meetings. Eighty-two percent (40/49) of respondents commented on aspects of the program intersection that they enjoyed or benefited from. Of these respondents, 73 percent (29/40) of respondents provided comments discussed below, and 28 percent (11/40) of respondents did not specifically provide further detail. Fifteen percent (6/40) of respondents reported difficulties or challenges in connecting these three components of the program.

The majority of comments about the integrated nature of the program were positive. Respondents to the open-ended question on program intersections noted four themes in particular: (1) skill building, (2) teamwork, (3) career or professionalism, and (4) breadth of sustainability topics. A third of the respondents took the opportunity to specifically comment on the integrated nature of the program as a positive aspect of the program and especially noted the ease of skill retention and application due to the timeliness of having simultaneous program components. For example, one student shared their experience:

Participating in the course, independent research, and group projects provided a clear opportunity to learn soft skills such as time management and communication skills. I recall we were required to describe how we applied lessons learned in class to our research methodology in the group project, which helped reinforce the lessons.

Open-ended responses pertaining to “skill building” fell into four different categories: time management (29 percent or 6/21); research skills (29 percent or 6/21); communication (14 percent or 3/21); and general skills/other (29 percent or 6/21). Those who mentioned time management as a skill said

that the challenge of multiple tasks and applying skills from one component to another improved time management. Similarly, respondents reported being able to apply research skills acquired from the class component to the group project and/or independent research components. Communication skills were reported to be acquired through community building activities, such as group work during class sessions and facilitated interactions within group projects. Other skills that alumni mentioned included research-specific skills such as GIS and skills to improve professionalism. Twenty-four percent (12/49) of respondents reported teamwork as a positive aspect uniting the different course components. Many respondents mentioned social engagement of the course to be helpful in improving teamwork skills; this included having a cohort and conducting a group project. Twelve percent (6/49) of respondents reported that career-related skills and/or professionalism were a positive outcome of the program. Responses that contained career-related implications were most often referring specifically to the group and independent research components of the program. These components were found helpful in increasing professional skills, including interacting in regular meetings with transdisciplinary groups, avoiding ambiguity, and expanding networks. Ten percent (5/49) of respondents reported the breadth of sustainability topics to be a positive aspect of the integrated nature of the program. Many respondents indicated the identification of new specific sustainability interests, which was a result of the wide range of previously unknown sustainability topics covered in the course.

Difficulty with connecting aspects pertaining to one component of the program to another was reported by 12 percent (6/49) of respondents. Four of these responses revealed a perceived disconnect between the independent research and other program components, while two identified a disconnect between the group project and other program components.

## **Part V: Program Improvement and Comments**

With respect to the open-ended question asking for areas for program improvement and general comments, the top five themes were identified as follows (in order of frequency of comments): (1) research experience and/or skills, (2) instructor praise, (3) resolving issues with faculty mentors, (4) project selection guidance, and (5) networking connections. Alumni commented that the program enabled them to enter the field of research and led to

their current trajectory. One student, who later became a Fulbright Student Researcher and a candidate in an advanced degree program in an Ivy League program, wrote, “Honestly it was the best experience that I had at UCLA, and probably the most crucial career development in my life. It really did enable me to get to where I am today as a researcher.” Students valued the assistance provided in exploring current academic literature on sustainability and new technologies with sustainability applications in their respective areas of interest.

Alumni praised having a strong instructor presence and detailed feedback on assignments. One student wrote,

Feedback from the instructor was very valuable throughout the program, and getting track change comments/feedback meetings were very memorable and appreciated. It’s a lot of effort on behalf of the instructor, but it felt very involved and improved the overall program experience. It’s not often students get such detailed performance evaluations from anyone other than their peers.

Open-ended comments reflected the participants’ gratitude for the support they received in maintaining connections with their faculty mentors. This included ensuring accountability of faculty research mentors’ commitment to engage with the students throughout the year and having regular, classroom-based guided reflections on research project progress and communication with their individual research mentors. Feedback further suggested the benefit of providing strong guidance and selection opportunities for being initially connected with faculty mentors. Students also appreciated flexibility on group-based work such as allowing self-selection of group members and group research topics based on mutual interests. Even if it delays immediate progress, allowing groups to develop and refine their own project and, in some cases, find an appropriate stakeholder to address an area of their interest was a productive learning experience. Lastly, students found networking opportunities to be rewarding, including interactions with peers, faculty guests, and sustainability professionals. One student summarized their experience: “The program is packed with so many amazing opportunities to learn and practice research and professional skills. I met many amazing peers and also networked with professionals in the LA area.”

## Discussion

We share here our conceptualization, program framework, and assessment of a transdisciplinary undergraduate education program focused on urban sustainability. Through the SLAGC URSP, undergraduate students deepen their understanding and connection to urban sustainability and are trained to understand how Grand Challenges can be solved through collaboration and the use of transdisciplinary research. Training this new type of student requires a combination of multidisciplinary knowledge bases and the application of soft skills to work collaboratively and to assess pressing issues from a systems perspective. In the academy, collaboration, research, and creative inquiry not only inform and include students, but also broaden and deepen classroom learning and support the development of a range of workforce skills. These skillsets are further useful beyond the scope of an academic program and are valuable in navigating interpersonal and professional spheres (McClure-Brenchley et al., 2020).

Our evaluation of the program suggests that students developed personal, research, and teamwork skills that supported them in solving urban sustainability challenges. Alumni reports of their present job descriptions at the time of the survey suggest that a majority of the students moved on to careers in sustainability, higher education, and positions that may not be within industries that are typically related to sustainability (e.g., a Carbon Associate at a large corporation, pharmaceuticals, and robotics) and that many have become involved in local and regional government agencies. Alumni provided feedback that supports the idea that the program had a cumulative impact greater than if the students experienced each of the program components separately. Most notably, students overwhelmingly agreed that the program enabled them to approach problems with a transdisciplinary mindset and increased their understanding of urban sustainability challenges.

The unique design of the three components of the URSP incorporates evidence-based teaching approaches such as active, collaborative, and experiential learning strategies, which deepen the learning process and support problem-solving across disciplines (Freeman et al., 2014; Andresen et al., 2000; Davidson & Major, 2014). On campus, students engage in independent research with faculty members that allows them to directly experience the research process and think critically to solve important societal questions.

Sustained participation in faculty mentor-led research also significantly supports degree success, likelihood to pursue graduate training, and persistence in the field of work (Hernandez et al., 2018; Sell et al., 2018). Collaborative problem-solving is applied to practices off campus in the form of group projects with external stakeholders where students are trained to solve real world problems by working together toward a common goal and depending on each other for their learning, which contributes to appreciating and validating diverse perspectives. Finally, active learning both (1) supports the development of sustainability competencies (Kioupi et al., 2022) and student career adaptability, as it provides students with the direct opportunity to reflect on their ability to work in careers related to sustainability (Hui et al., 2021); and (2) reduces achievement gaps between “advantaged and disadvantaged” students through a highly structured classroom experience, i.e., with multiple weekly assignments and regular student engagement (Haak et al., 2011; Theobald et al., 2020). Together, this curricular design represents an effort to create lasting learning self-efficacy that translates into tangible, transferable skills that can be applied to transdisciplinary problems.

There are several limitations of this alumni study that must be acknowledged. All alumni data were pooled, as disaggregation of the data by year of the program would have resulted in small sample sizes. The SLAGC URSP is a constantly evolving program that has had many minor but accumulating changes, including a change in instructor after the first two years. Recommendations suggested by students are incorporated into the program each year, and mid-year feedback is now used to adjust the program immediately to students' needs. The most significant changes have been to increase the role of student participation in matching with faculty mentors over the summer preceding the program and changes to the group projects. Group work continues to be driven by the students' interests but has also become more stakeholder driven with a focus on community engagement and service. For example, since academic year 2020–2021, the final deliverable for the group project has not necessarily been a formal written report, but a set of deliverables developed in collaboration with the stakeholder. The varying time intervals between alumni participation and the survey may have influenced the survey results through recall bias and/or potential shifts in perceived impact caused by changing external circumstances and evolving long-term outcomes. For example, the COVID-19 pandemic began at the end of the 2019–2020 academic year, and as such, affected the program and students directly that year, while also having impacts on SLAGC URSP alumni careers

and trajectories. While none of the program alumni who responded to the survey were in the program during the pandemic, it was still important to understand its impact on their career trajectories.

An intentional and proactive evaluation approach that ensures that the program evolves to meet changing needs and that feedback can be regularly received is crucial to a program that seeks to address socially complex challenges like urban sustainability. In order to evaluate teaching effectiveness and the impact of the course on student skillsets, a similar survey instrument has been administered each year to students who have completed the SLAGC URSP. To evaluate longitudinal impacts, we plan to follow up with alumni at five-year intervals, as students pursue careers post-graduation and enter graduate school, for those who pursue it.

## Conclusions

In our efforts to create the next generation of Grand Challenge problem solvers, we expect students to leave the SLAGC URSP with (1) an understanding of the research process, (2) an appreciation for the collaborative and transdisciplinary nature of urban sustainability research and its application, and (3) knowledge of how they can apply their specific interests and skillsets to a career in sustainability. Work remains to implement adaptive evaluation tools to ensure ongoing program improvement. In the future, the program will standardize evaluations of the current cohort each year to evaluate teaching effectiveness and student outcomes and continue to engage and leverage its growing alumni. The network and data will be used to foster a learning environment that embraces effective learning strategies and to combat the dynamic urban sustainability challenges present in our communities. Although it was not addressed in this study, student enrollment in the SLAGC URSP has reflected a steady increase of 175 percent in the representation of humanities and social science majors in recent years (2018–2022) and enrolls Academic Advancement Program students at a percentage equal to or higher than their relative abundance on campus. The URSP scholar diversity data are a separate dataset and area of current/future research.

With the launch of the SLAGC, the university committed to creating spaces for collaboration and partnerships across disciplines and sectors to accelerate solutions to urban sustainability challenges. The SLAGC URSP is

only one way in which the initiative is doing this and overall has been a great success in building these bridges. The costs of this program are rather minimal with respect to the impacts; once established, it requires a half-time commitment from an instructor year-round, and a 25-percent-time teaching assistant has been added in recent years to support the growing enrollment. Finally, group project work is supported by a budget of \$10,000 per academic year. UCLA has become an essential partner and contributor to regional sustainability efforts and will continue to increase opportunities for students through expanded partnerships with local government, nonprofits, community organizations, and businesses to create the most sustainable megacity by 2050. The SLAGC URSP is committed to sharing progress and lessons learned from this effort as one case in a rich literature of teaching and learning in transdisciplinary education in higher education (e.g., Evans, 2015; Neuhauser & Pohl, 2015; Schrot et al., 2020). We are encouraged by the ability to learn from others conducting similar programs and initiatives that aim to solve the complex urban sustainability challenges of the twenty-first century.

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## 6. Fickle Winds

### *Faculty Maintenance, Labor, and the True Cost of Transdisciplinary Initiatives*

STEPHANIE SADRE-ORAFAI AND JORDAN TATE

What is the temporality of transdisciplinarity? Is it durational—always a becoming in relation “across, into, and through” (Hayward & Weinstein, 2015, p. 196)—or a receding horizon that breaks new paths without worrying about the care required to maintain them (Bowker, 2015; Zárata, 2018)? For us, the answer to this question is key to understanding how faculty, students, and administrators see the value in and distribute the costs and labor of transdisciplinary initiatives in higher education. In 2011 we founded Critical Visions, a cross-college undergraduate certificate program that blends critical theory, social analysis, and art, media, and design practice at the University of Cincinnati, a large, public, urban, research-intensive university in the Midwest. While newly appointed tenure-track faculty when we launched the program, we have sustained Critical Visions now for more than a decade—weathering shifting administrative priorities of four university presidents, four provosts, five deans, and nine unit heads between us (not counting interim title holders), budget cuts, austerity measures, a pandemic, and the ups and downs of our personal and professional lives. We have witnessed how our perspectives about this work and its value have changed across time and our own positions at the university, how students and alumni have found value in it, and how those inside and outside the university have responded to it.

In this chapter, we use Critical Visions as a case study to provide a first-hand faculty account of creating and, more importantly, maintaining a transdisciplinary program. Contextualizing infrastructural and institutional impediments to transdisciplinary teaching at our own university, we show how top-down Grand Challenge initiatives in the 2010s provided a unique opening, but one whose elasticity was restricted by an institutional (and broader cultural) focus on innovation. As STS scholars Andrew Russell and Lee Vinsel (2017) write, “Unlike innovation, which has a cottage industry devoted to its study and cultivation, maintenance is not something we spend

a lot of time trying to understand better” (para. 10). We argue, however, that the durational qualities of maintenance and the infrastructural work transdisciplinary programs like ours seek to do—to reroute resources and reconfigure the university—are what gives them their potency, beyond their immediate, tangible deliverables or ability to scale (cf. Tsing, 2012). In this chapter, we show how a focus on innovation amplifies fickle institutional winds—sweeping up faculty and programs, buoying them for a time, but ultimately leaving them adrift, without resources to maintain transdisciplinary programs.

Reflecting on how we have sustained our program, we examine how high rates of turnover of upper administration and shifting institutional priorities impact nascent transdisciplinary programs; how faculty manage it; and the mixed outcomes of institutionalizing and formalizing programs of study, particularly amidst austerity measures. We reveal the kinds of unpaid administrative labor faculty take on to pursue and sustain transdisciplinary curricula and how their relationship to this labor changes over the life course of their relationship with the institution (i.e., pre-tenure, post-tenure, through research and parental leaves, and so on). We highlight the need for attention to on-the-ground realities of the students and faculty that engage directly with these programs and initiatives, arguing that by better understanding faculty and students’ perspectives, we can build better systems and structures for these kinds of programs to flourish, while also gaining a better sense of their true cost and impact.

## No New Resources Needed

In writing the history of the program for this chapter, we have been careful not to just repeat our own mythology: the story we tell administrators, funders, and collaborators, which, depending on the audience, is either one of intrepid, confident innovators or scrappy, stubborn scroungers. Instead, we want to reflect critically on the accumulated labor, happenstance, and durational qualities of developing and maintaining the program—how the program’s meaning and value have shifted for us and others over time, as well as the broader contexts and relationships that have informed it. We also want to attend to not only the transgressive dimensions of the project, which we typically highlight as what is new and different about the program, but also

the conservative tendencies to reproduce our own educational experiences. To do this, we shift our focus from the work of establishing the program, its curriculum, and infrastructure (which we've documented elsewhere, see Sadre-Orafai et al., 2018), to the work of maintaining it and, by extension, repairing the university. As STS scholar Steven Jackson (2015) writes, "Repair reminds us that the loop between infrastructure, value, and meaning is never fully closed at points of design, but represents an ongoing and sometimes fragile accomplishment" (para. 5).

Our original goal was modest: to co-teach a course between fine art and anthropology on visual culture. Despite the university's stated message of fostering and supporting inter- and transdisciplinary research and teaching, we immediately confronted infrastructural resistance. The main impediment was the university's performance-based budgeting (PBB) model. Adopted in 2006 to stave off bankruptcy by increasing student enrollments, PBB had the unintended consequence of pitting colleges against one another, disincentivizing cross-college collaborations (Fischer, 2019). Under PBB, the Provost's Office set revenue thresholds for colleges based on student credit hours. Those who exceeded their targets were rewarded with revenue sharing and those that did not with deficits. Since the university's goal was growth, the thresholds were always increased, making it difficult for colleges that failed to meet their centrally set enrollment targets to ever meet future ones. College administrators emphasized the importance of "butts in seats," keeping majors within one's own college and creating courses that would appeal to other colleges' majors who, in the PBB formula, were worth more. This competition for students was amplified in the lead up to semester conversion in 2012, as colleges developed their own general education courses in a bid to retain more student credit hours. This led to the College of Arts & Sciences having an \$8M budget shortfall in FY2013, compounded year after year, leading to units in the college raising local funds to cover their operating budgets.

Yet despite being an obstacle, PBB also perversely provided a solution. In a bid to boost college enrollments, the associate dean of undergraduate education in Arts & Sciences (A&S) encouraged faculty to develop certificates as a no-cost way to create more value within the college. These certificates would package existing course offerings into tracks that students could add to increase their marketability after graduation or more purposively fulfil their general electives. We built out a certificate that both drew on existing courses and provided a rationale for creating two new ones: a junior-level

visual culture course Stephanie could offer in the Department of Anthropology and a co-taught capstone in which we could bring our approaches and methods together. We were careful to balance the number of credit hours in the certificate evenly between the two colleges and to develop benefits for each kind of student. For A&S students, the certificate offered access to sophomore studios in fine art without the Foundations requirement. We imagined the program would start and stay small, which helped us get buy in from fine art faculty. For fine art students, half of the curriculum was already built into their major, requiring just two extra courses, one of which could be applied to their general education requirements. For our proposal to succeed, we were encouraged to affirm that our program required no new resources.

The key that opened the door to our ability to co-teach and collaborate was also the one that locked us into being entrepreneurial, forcing us to focus not only on the value of the program, its impact on students' experiences, possibilities, and academic rewards, but also to consider how we may eventually be able to survive as a program. We had to seek out ways of securing support to sustain the program we had started. As new faculty, we were somewhat naïve about the amount of time, energy, and resources we would need. We assembled an advisory board of other faculty, but apart from one-off critiques for students, we rarely consulted with or called on them to help with the day-to-day work of running the program. We were so focused on achieving our goals—not just teaching together but training the kinds of students we wanted to see in our classes—that we were willing to sacrifice our work-life balance, investing more and more of ourselves and our energies into the program.

## Innovation through Repetition

In designing the curriculum, we drew explicitly on models from Stephanie's graduate education experience. These included New York University's culture and media certificate (also co-founded in 1986 by a then-new, untenured faculty member, Faye Ginsburg), jointly administered by the Departments of Anthropology and Cinema Studies that stressed the reciprocal relationship between theory and production, and the Graduate Forum on Forms of Seeing (where we borrowed the name for Stephanie's core course),

an interdisciplinary salon that brought together students from the Institute of Fine Arts and Graduate School of Arts and Sciences to discuss and exchange methods, theories, and approaches to visual culture. Implicitly, however, we drew from our own formative undergraduate experiences that had shaped our pedagogy and institutional involvement: the Western College Program at Miami University for Jordan and the Haas Scholars and DeCal programs at the University of California, Berkeley for Stephanie. In retrospect, looking at the fate of these programs and how they were structured (and re-structured) has been instructive. It has helped us recognize where we locate value in working beyond disciplines, how it has shaped how we have tried to reproduce it, and the baggage that comes with it.

The Western College Program at Miami University was founded in 1974 when the Western College for Women merged with Miami University. Offering a four-year bachelor of philosophy in interdisciplinary studies, the program ran topical, interdisciplinary seminars that focused on systemic, interdisciplinary thinking—enabling students to craft their own individualized curriculum with access to courses without needing to satisfy prerequisites. The hallmark of the program was an interdisciplinary, research-based thesis project that encapsulated and synthesized each student's path through the program in a thesis project expected to breach fifteen thousand words and/or have a significant creative component. In Jordan's cohort alone, topics ranged from masculinity studies to Martian terraforming. While Richard Moll (1985) cited the Western College Program as a primary factor in listing Miami University as one of the "Public Ivys" in 2007, Miami University restructured the program and degree, enmeshing it within the College of Arts and Sciences, now conferring a bachelor of arts in individualized study. This mirrored shifts at other colleges and universities, such as the Paracollege at St. Olaf College (Newell, 1984) that was shuttered in 2000. These once distinct, autonomous, and student-driven programs are either being folded or integrated into the university's broader structure. Concurrent with the shift toward top-down calls for transdisciplinary and problem-based approaches with broad applicability, these trends undercut many of the organically developed alternative educational spaces within the university.

For Jordan, the Western College Program was a strong foundation for his artistic practice. More sans-disciplinary than inter- or trans-, the program enabled participants to comfortably work outside of their disciplinary boundaries. The reality of building and maintaining a transdisciplinary pro-

gram posed a larger system of constraints but led to a richer set of rewards. Whereas interdisciplinarity in fine art most often means using extra-disciplinary resources, references, modalities, or processes and bringing them squarely back into a fine arts context, a transdisciplinary approach demands engagement and growth, flexibility, and reflexivity.

Like Jordan, Stephanie also pursued an interdisciplinary senior honors thesis, albeit one within anthropology with a mentor from African American studies. She was part of the second cohort of the Haas Scholars Program (HSP), a competitive funding mechanism that supports students with financial need from across the university to pursue independent scholarly and creative research under the direction of a dedicated mentor. In 1999 the award came with a research budget and stipend of about \$10,000 for the student and a small stipend for the faculty mentor. Made possible by an endowed gift from Robert and Colleen Haas, the program does not offer degrees or set a specific curriculum, but rather serves as a shared context for students to foster an appreciation of interdisciplinary approaches and professionalize them. The mentorship, funding, and alumni network are strengths of the program that has run continuously for over twenty-five years, supporting more than five hundred students.

Beyond HSP, Stephanie also participated in DeCal, or the Democratic Education at Cal program, a platform for student-initiated and student-led courses with roots in Berkeley's Free Speech Movement. Working with a faculty sponsor in the Department of Music, she developed and taught an upper-division, one-credit course based on her senior honors thesis research. Everyone's involvement in the program (apart from the students enrolled in the courses who pay for credit hours) is volunteered and unpaid. Looking back, Stephanie sees how the idea—that to do what you love and what is critical to supplement the university's offerings, you must be willing to do it for free—profoundly shaped our approach to building Critical Visions. More importantly, though, it foregrounded the agency of students at the university and the creativity of working around bureaucratic structures, which was also at the heart of our approach to establishing the program.

## Maintenance Required

Institutionalizing Critical Visions came with implied maintenance requirements both for us and the institution. While certificate programs could be closed or shuttered, once made available to students to enroll, the university had a commitment to see those students through the end of the program. Initially this was attractive to us. With a program to support, our unit heads would have to let us teach these courses and count them fully in our workloads, giving us more say over our pre-tenure courses. What we did not fully appreciate at the time, however, was the amount of administrative work involved in maintaining the certificate: staffing the courses, recruiting and advising students, reviewing electives, approving course substitutions, and certifying graduation requirements had been met. This work was neither offset by reductions in our other research, teaching, or service obligations, nor did it come with an annual budget for support. Moreover, as pre-tenured faculty, this kind of institution building did not fit neatly into the research, service, or teaching categories on which we were evaluated. To say that building and maintaining a program was equivalent to a regular teaching load or a broader university service—when it drew from and informed our research practice—seemed inaccurate. Still, we were excited to create something that provided what we thought was missing at the university. Any funding we secured to support it was through competitive internal funding mechanisms, many of which reflected the shifting visions of upper university administrators.

For example, in 2011 we received \$17,240 in faculty development funds—a pool of funding guaranteed by our collective bargaining agreement—from the Provost's Office to host Look Better, a cross-college symposium on interdisciplinary visual culture research, practice, and pedagogy, which we used to launch the certificate. The following spring, the Provost's Office announced a request for proposals for their new signature program UC Forward. The program sought to bring together students and faculty from multiple disciplines, to use collaborative methods, and to produce transformative solution-oriented outcomes. Innovation-oriented, the program offered \$10,000 per course, renewable for up to three years. We were able to argue in our request that creating a student journal would build on the investment the university had already made through the symposium and that we could get the symposium participants to serve as its editorial board.

Recognizing the barriers to cross-college and transdisciplinary teaching, the funding application required letters from our unit heads and deans agreeing to offer the course and count it toward our regular teaching assignments. While creating the program enabled us to create and co-teach a course, funding from UC Forward guaranteed we would be able to offer the course in a way that produced a tangible product that we could circulate.

The UC Forward funding covered printing and shipping costs for the journal as well as being able to host an editorial/production mentor and design mentor for the students. While we both brought different publishing and design experiences to the course, having experts who could mentor both the students and us was immensely helpful. While we started with a large group of students in our first cohort, drawn in through the symposium and students we taught in other classes, the second cohort had only five students ([table 1](#)). Our units and UC Forward wanted to see more students in the next iteration of the course, so we opened seats to graduate students outside of the program and visited classes that were electives in the program to actively recruit more students. We switched to a biennial capstone and publication, taking on independent studies during off years to ensure students enrolled in the program could graduate on time. Because we had created the program and felt a deep investment in it and the students, we took on this extra work.

For our third iteration of the capstone, we looked for other resources to sustain the program. Jordan applied for an Arts, Humanities, and Social Science Facilities Grant sponsored by the Office of Research to purchase a Risograph, a digital duplicator, to start an art book press with other fine art faculty, allowing us to move production in-house. This meant more labor, both for us and the students, but more sustainability for the course and program. Whereas we were spending \$5,000 on production (with the other \$5,000 going toward the design and editorial/production mentors' visits), we could instead spend between \$1,000 and \$2,000 for ink and paper every other year going forward, which would be more manageable to fundraise.

While Jordan was unable to co-teach the third iteration of the capstone due to competing fine art scheduling demands, he secured the Risograph, learned to use it, and coordinated production for the third issue. Still, a staffing issue remained. No other full-time faculty members were able to co-teach the course, in part because their workloads were already tied up in their units, but also because the capstone was listed under fine art and anthropology only. We found an adjunct artist-researcher to co-teach the class but quickly realized how much more work the course was than what

we could expect from someone without a permanent stake in the program. To offset this, Sso-Rha Kang, an alumna of the program and then graduate student in art history, joined as an unpaid teaching assistant, earning independent work credit instead to serve as the associate editor. Reflecting on her experience going from student to associate editor, she wrote:

What I felt was crucial to emphasize was intentionality, concept, and execution—the very things I wish I had developed an awareness of earlier in my capstone. In response to their enthusiasm and eagerness, I wanted the students to develop an awareness of the difficulties they would face in creating a publication from scratch. They would inevitably come to understand this at a more personal level through the process of trial and error (Sadre-Orafai et al., 2018, p. 160).

When the editorial/production mentor Sina Najafi, founder and Editor-in-Chief of *Cabinet* visited that spring, we gathered alumni from the program to connect with him and current students in the program. This helped us spread the benefit of Sina's visit to our alumni and show our current students what our alumni were doing after graduation. This community building was vital for us and the students, both personally and professionally. It fostered a sense that the program would endure.

As our initial funding dried up, we looked toward other modes of sustaining the program. Frequently, this meant expending personal or institutional capital to continue the level of support we wanted our students to have. We asked colleagues to serve (or continue to serve) on the editorial board, extended department colloquium speakers' campus visits so they could serve as editorial/production mentors, repurposed our graduate research assistants to help draft elective course lists each semester, and requested one-time support from center directors to offset publication costs. It also meant being creative with other resources and opportunities. Jordan secured printing and binding equipment for other initiatives that we could both use. We bought up extra ink, drums, and masters for the Riso-graph to use in future capstones when we had budgets for other projects that overlapped. This ingenuity was born out of our acceptance of a permanent state of austerity within the university. Yet without it, we would not have attempted to secure access to a high-volume printer, binding setup, and what is now an operational imprint at the University of Cincinnati,

nor would we have focused on more time- and labor-intensive techniques (e.g., hand-developed blueprints, embossed covers, rounded corners, stapled signatures, multiple paper sizes and types bound into a journal) that have encouraged more creative engagement with production and materials, both for us and the students. Andrew McGrath, a member of the third cohort, remarked:

While our book made full use of digital and virtual workspaces through its conception and design, the resulting object was ultimately the result of tangible bodily labor. From a pedagogical perspective, the materiality of the project set limitations that funneled ideas into realistic possibilities based on form, cost, and time. But, unlike the first two publications, ours was the first to be produced entirely in house. For the last month of the course, we worked in shifts outside of class to print, stack, dry, trim, collate, bind, and trim again the pages for the final book. We also split the labor of copyediting one another's texts, troubleshooting design issues, and pitching in where each of us could (Sadre-Orafai et al., 2018, pp. 158–9).

## Repairing the University

Moving production of the journal in-house meant a more compressed timeline for the capstone, which often bled into the summer—a month or more after classes had finished. When we had a critical mass of students with interests in production and experience bookmaking, this was not a major issue. Indeed, early on, the excessive workload of the program and the capstone felt like a point of pride, a kind of demonstration of our commitment to the program and its students, but three years into the pandemic and three children between us later, this has shifted. It seems unfair to ask so much of students, many of whom we encounter for the first time in the capstone without having had them in an earlier course, due to our own post-tenure sabbaticals and research and parental leaves. In our absences, too, the program has attracted a wider array of majors, many of whom do not have print production experience since our curriculum needs to be flexible enough to accommodate any kind of art, media, or design practice. We've pared back the syllabus considerably to make room for production, but it still seems like

too much to ask of ourselves, or guest faculty who have co-taught the capstone in our stead, to lead a group of students through the process of identifying a topic, researching it, writing a compelling essay, and creating a body of work, which they then collectively design, edit, print, and bind within fifteen weeks. It raises the ethical question, too, of not only the cost and value of transdisciplinary programs like ours when there is a top-down desire to seed but not support them, but also us modeling for students the role of the committed faculty member when the program is meant to challenge systems, structures, and inequities that we are implicitly supporting through this kind of overwork.

Indeed, the increasing reliance on concrete performance metrics in higher education has shifted expectations of performance to measurable outcomes rather than durational experiences. Sociologist Juan Pablo Pardo-Guerra (2022) has shown how quantitative research evaluations lead academics to become more conservative in their research and less likely to explore new or uncertain directions. This paradigmatic shift challenges the value of interdisciplinary education. Our own institutional evaluation rests on peer review of our research, shared assessment of service, and self-assessment of our teaching—augmented by demonstrably ineffective and biased student evaluations (Esarey & Valdes, 2020). Much of this reflects institutional priorities that rest on the recruitment, retention, and matriculation of students rather than providing the best possible educational experience. This manifests as support for new initiatives that ebb and flow with educational trends and upper administrators' pet projects that are not holistically supported by longer term structural and institutional changes. Without transforming the underlying structures and the enduring, compounding reward systems, university administrators will not be able to create environments for transdisciplinary scholars and programs to thrive.

Reflecting on these notions of value (and comparative metrics used to evaluate the institutional, rather than educational, success of a program), the outcomes frequently (and problematically) outweigh the process. Given the disparity in structures and intent, we often use metrics to measure our students' successes that fit the evaluative methods of our peer reviewers (i.e., the originality of the creative work, the nuance of its critique, and evidence of rigorousness of the research) rather than the tangible metrics used to measure certificate programs' performances, like number of students enrolled, cost per student, student-faculty ratio, and so on. As Stefano Harney and Fred Moten write, "it cannot be denied that the university is a

place of refuge, and it cannot be accepted that the university is a place of enlightenment” (2013, p. 26). They continue, “In the face of these conditions one can only sneak into the university and steal what one can. To abuse its hospitality, to spite its mission, to join its refugee colony, its gypsy encampment, to be in but not of—this is the path of the subversive intellectual in the modern university” (2013, p. 26). Is repair possible within the space of the university, or is fugitivity the only ethical relationship one can have?

While the student experience in the Critical Visions Program mirrors our idealized version of an undergraduate research experience, it requires a disproportionate amount of unpaid labor and service that is unsustainable. We rely on dozens of artists and academics to serve on the journal’s editorial board and provide feedback on students’ projects each capstone. We depend on overtasked contingent and tenure-track faculty (ourselves included) to teach the capstone and program alumni to serve as volunteer guest critics and associate editors. While this kind of service is common in academic settings, the networks of support for scholars and artists that offset this have dwindled. Not only does this challenge our ability to practically run a program with limited institutional support, but it also begs the question of whether or not we should be leveraging a significant amount of faculty and student time, institutional capital, and colleagues’ contributions to repair a broken system.

While universities continue to call for transdisciplinary programs, scholarship, and teaching, underlying structures like tenure lines, enrollments, and hiring decisions remain relegated to narrow disciplinary boxes, with jointly appointed faculty carrying more of the burdens of service. These tensions wear on faculty, making it harder not only to do the work, but to endure without burning out. When it is the faculty member’s own research, which can be more easily transposed to new institutional contexts, one may be nimble enough to maneuver around these roadblocks, but as a program embedded within a particular institution and university structure, faculty must find more complex solutions or be content to let it wither away. Our program, while perhaps valuable to the university on some level, does not drive funding, enrollments, donors, or prestige in ways that lead to commitments to support and sustain it.

There is a nagging feeling, a generational one perhaps, the residue of hustle culture, that maybe if we had done it *better*—if we had made a self-sustaining business model or gotten the work placed in the right spots—we could have secured sustained support from the administration. Ultimately,

we recognize this is misplaced. We have been able to maintain control over the program and have gotten back what we put into it because we see the value from the students firsthand. This is not the kind of program that scales, but it is the kind of program that can be quietly tended—a refuge for students and for us. We have benefitted tremendously from the embedded, long-term engagement and exposure to one another’s methods, theories, and practices, both as educators and as researchers. Without the *work* required to navigate among, between, and within multiple academic disciplines, we would not have the capacity or skill to do so or help others through these paths themselves. Yet, beyond the work it takes for successful transdisciplinary collaborations, there is the additional labor of taking what seems like small numbers of students completing the work and showing the personal impacts these programs can have.

As anthropologist Salvador Zárte (2018) argues, “Maintenance is the constant repetition of life-creating labor” (para. 10). While the labor of maintenance effaces itself to provide platforms and ease for others, its affective charge accumulates, shaping those around it on an interpersonal level. We argue that despite the different scalar and temporal expectations and experiences of transdisciplinarity from university administrators, faculty, and students, the care we put into the program and into our students endures, adding static to the system. While from a university administrator’s perspective our program could be seen to not generate enough revenue or value, at the faculty-student level we see the benefits. The tangibility of the journal we produced and circulated to colleagues at other institutions reinforces its value. Whether or not we are able to attract donors, recurring institutional funding, or growing enrollments, we maintain autonomy over the program and ultimately decide on what terms it will continue or end.





## Notes

+ Once we began offering the capstone every other year, graduating seniors who missed the capstone completed independent projects co-directed by both of us, on the themes of identity (2015), repair (2021), and subject/object (2023). The themes for publication-based cohorts were space (2013), the future (2014), color (2016), surface (2018), identity (2020), land/water (2022), and artifact (2024).

\* To both meet course registration minimums and to pilot a graduate track for the program, we began enrolling graduate students in the capstone in 2016, with four in 2016 (anthropology, art education, professional writing, and women's, gender, and sexuality studies), two in 2018 (both fine art), three in 2022 (all anthropology), and two in 2024 (both fine art). These major counts include these graduate students even though they did not earn a certificate in Critical Visions.

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# 7. How Does Transdisciplinary Teaching Transform Those Who Teach It?

*Experiences from the University of Technology Sydney*

ALEX BAUMBER; BEM LE HUNTE; GIEDRE KLIGYTE; SUSANNE PRATT;  
JACQUELINE MELVOLD; AND LUCY ALLEN

In Australia, there is a recognition that global crises, including a changing climate, disruptive technologies, and increasing social, economic, and political instability, require new coordinated responses. Education of high-skilled workers is one way to address these disruptions (Australian Government, 2022; Australian Productivity Commission, 2022). However, this is typically framed in economic terms, with Australian universities being steered through policy to develop “job-ready” graduates who can fulfill employer needs (Australian Government Department of Education, Skills and Employment, 2020). The narrow employability discourse that links outcomes of university education to current industry needs fails to acknowledge that future shocks are likely to demand new, yet unknown types of responses and capabilities. As an alternative to this employability discourse, some Australian universities are experimenting with transdisciplinarity and real-world, challenge-driven approaches to education (e.g., University of Technology Sydney, Australian National University, Western Sydney University).

Transdisciplinary approaches to higher education are underpinned by the belief that university graduates should be equipped with the skills and tools required to face uncertainty and disruption and contribute to positive social and environmental impact. Transdisciplinary approaches have been expanding globally across a diverse range of contexts in higher education over recent years, including sustainability (Evans, 2015), health (Hudson, 2016), and entrepreneurship (Penaluna & Penaluna, 2009). This type of education is characterized by a focus on learning between and across disciplines in recognition that many of the complex societal challenges we face cannot be addressed by any single discipline and instead require a combination of deep

disciplinary knowledge and collaborative, integrative, and creative capabilities (Fam et al., 2020; Markauskaite et al., 2020).

The Bachelor of Creative Intelligence and Innovation (BCII) at the University of Technology Sydney (UTS) is an example of a transdisciplinary undergraduate program that was introduced in 2014. It consists of a “core” degree in one of twenty-five different fields (e.g., business, science, communications, design) alongside a four-year transdisciplinary curriculum that brings students together from the different core degrees to work together. These transdisciplinary subjects typically involve working together to address complex real-world challenges set by external partners while progressively building up a repertoire of methods such as rich pictures and causal loops to analyze complex systems and transdisciplinary activities like the “perspective relay” in which students generate insights by adopting the perspective of a different discipline over multiple “laps” of an area.

The BCII initial intake in 2014 was around one hundred students but has since grown to exceed three hundred new starters each year and over one thousand students across its four-year program. Its success has been recognized on the global stage through a Reimagine Education Award and an International Green Gown Award for Next Generation Learning, as well as through national awards from Engagement Australia and the Australian Awards for University Teaching (AAUT). Internally, BCII teaching staff have been recognized for their scholarship in transdisciplinary learning practices with the awarding of the 2021 UTS Medal for Excellence in Research-Teaching Integration. Previous research into the BCII program has analyzed different ways of conceptualizing partnerships with students around curriculum co-creation (Baumber et al., 2020), creating “third spaces” in which boundaries can be transgressed (Kligyte et al., 2019; Kligyte et al., 2022), and enabling factors for teaching system resilience during the COVID-19 pandemic (Baumber et al., 2021).

The BCII’s success has resulted in the creation of a dedicated pan-university entity, Transdisciplinary (TD) School, to promote transdisciplinary approaches at UTS. In addition to the BCII, TD School also hosts master’s programs in data science and creative intelligence, the Diploma in Innovation, and a new Transdisciplinary Electives Program that offers every undergraduate student a BCII-like experience during their time at UTS. While the BCII proved popular with students from its launch in 2014, its success was not assumed from the outset. Rather, BCII was viewed as a “safe-to-fail experiment” at UTS, operating under early financial constraints with only

one full-time salary invested in the program for the first three years of its life. Designing a new transdisciplinary program from scratch demonstrated the radical ambition and strong institutional support that have been crucial to the program's success over the past decade.

A transdisciplinary agenda like the one that led to the creation of the BCII is wildly ambitious, and the uncertainty about the outcome had to be accepted on some level. Previous institutional attempts to assemble transdisciplinary education offerings at UTS had lacked the BCII's ambition and had not come to fruition. They had been designed as a patchwork of courses from across the faculties rather than the BCII's ultimate model of an entirely new curriculum, which enables students from different faculties to come together around shared, partner-led, complex challenges. Upon witnessing the success of the BCII as an experimental innovation, the university has been inspired and transformed by it. The tried and trusted (and externally recognized) transdisciplinary education approaches are now placed within TD School as a pan-university entity and positioned to have greater institutional impact.

Some of the key transdisciplinary concepts that the BCII curriculum draws on include the integration and transcendence of academic disciplines, the participation of diverse stakeholders, creativity, a focus on “real-world” problems, a recognition of complexity, and the need for explicit processes of reflexivity to enable mutual learning and knowledge integration (Klein, 2017). The integration of different knowledges and epistemologies requires participants—students, educators, and external partners—to be both willing and able to respect, understand, adopt, and generate new forms of knowledge, and to challenge traditional roles and power structures in the pursuit of mutual learning (Polk & Knutsson, 2008). In adopting the principle of mutual learning, students are not the only ones who learn in transdisciplinary teaching programs. Teaching staff are also positioned as learners who can be transformed through the delivery of the BCII program.

Transformative learning is of particular interest to transdisciplinary scholars and practitioners seeking to create real-world impact through engagement with diverse perspectives. In addition to seeking to create change, it involves the transformation of one's beliefs about themselves and the world around them (Mezirow, 1991). Transformative learning may be facilitated by exposure to alternative viewpoints and “consciously directed processes” that enable one to critically analyze their received assumptions and worldviews (Elias, 1997). These moments of learning can happen through “peak trans-

formative experiences” where profound and lasting insights into self-identities, values, and the nature of reality are obtained (Le Hunte et al., 2022). The ability for transdisciplinary approaches to stimulate transformative learning in higher education has been highlighted in previous studies (Baumber, 2021; Leal Filho et al., 2018), but the focus has typically been on how students rather than staff are transformed through their learning.

In this chapter we analyze what we have learned as a group of transdisciplinary teaching staff through our delivery of the BCII program over several years—and how this learning has transformed our practices, worldviews, and underlying assumptions about teaching and learning, knowledge, and the purpose of university education. We also seek to identify the key moments in which these transformations have taken place and the factors that enabled this transformation.

## Methodology

To identify our peak transformative experiences in teaching BCII and the factors that enabled them, we came together as a diverse team of six current BCII teaching staff who had recently been awarded the 2021 UTS Medal for Research-Teaching Integration. Most team members had around five years of teaching experience in BCII, including Alex (disciplinary background in environmental policy); Giedre (education); Susanne or “Susie” (creative arts and environmental humanities); and Jacqueline (science). One member, Bem (anthropology and creative writing), had considerably more experience as the Course Director who launched the program in 2014, and another member, Lucy, was a BCII graduate with a core degree in design who had transitioned into an academic role in 2018.

Drawing on the transdisciplinary principle of reflexivity (Polk, 2015), we formed a “reflection circle” (Labonté, 2011) positioning co-authors as equals in a conversation. In our reflection, we employed an appreciative inquiry approach, a strength-based positive form of inquiry focused primarily on identifying positive moments of transformation (Jones & Masika, 2021). Our sixty-minute dialogue was recorded over Zoom, with one absent team member integrating everyone’s responses afterwards. To ensure that all team members had equal opportunity to speak, participants had to use the “raise hand” reaction on Zoom to indicate they wished to take their “talking turn”

(Itzchakov & Kluger, 2017). The discussion transcript was summarized by the lead author using thematic analysis to identify recurring themes before being reviewed by all participants as part of a collaborative writing process for the discussion section of the chapter.

The three guiding questions for our discussion of transdisciplinary teaching and transformative learning were:

- How have we been transformed since coming to TD School (i.e., how have our preconceived assumptions or premises about learning and teaching been challenged)?
- What have been our peak transformative learning moments?
- What helped or enabled us to transform (e.g., processes, conditions, etc.)?

## Results – Reflection Circle

### **Q1: How have we been transformed since coming to TD School?**

The first discussion question focused on how we had each transformed since coming to TD School. Key themes arising in response to this question included: a shift from feeling the need to be an expert toward a more open approach; becoming comfortable with uncertainty; negotiating power dynamics; and adjusting to different language and terminology.

With regards to the change in teaching styles, Susie described this as moving from the “sage on stage” mentality and lecture-tutorial format that is dominant in traditional education settings toward “creating space for emergence to happen and holding space for that emergence.” For Giedre, the change was from “imagining something quite concrete or prescribed that the students might achieve” to “a much more open and invitational approach to how you engage students.” Jacqueline also reflected on the different positioning of the teacher as feeling like needing to have “seventeen different hats” when walking into a classroom in order to deal with the complexity and diversity of the challenges that students are working on, recognizing the dif-

ferent stages of creative problem-solving and dealing with the uncertainty around how this process might play out.

Becoming comfortable with uncertainty was a key change that many of the team reported undergoing since joining TD School. For Alex, this was about “knowing that emergence is going to happen, but not what direction it’s going to take.” Bem noted that we not only encourage and enable our students to explore unknowns but also have had to do this work ourselves. She noted that “when I started as Course Director, we had to invent our type of transdisciplinary education from scratch. There was no blueprint, so we were always tackling unknowns. We had to question everything and anticipate student responses. Would assessments befuddle or inspire students? How far could we push them?”

Shifting power dynamics was something that each teaching team had needed to adjust to upon joining TD School. This was particularly pronounced for Lucy, who had made the transition from a BCII student to a member of the teaching team. She noted that key challenges were becoming comfortable with collaborative teaching and feeling out of her depth, but support from colleagues helped her to feel that her expertise and perspectives were valued, regardless of “whether I had ten years of experience or six months.” Bem argued that transdisciplinarity destabilizes traditional power relationships through mutual learning in which “the teacher is the student, and the student is also the teacher.” This idea on mutual learning was also reflected on by Susie, who noted that external industry and community partners are also part of that relationship, with the role of academic staff member often flipping between teacher, learner, and a kind of “events coordinator,” facilitating interactions between students and external partners.

The final theme that was discussed in relation to the opening question was around language. Coming together with colleagues and students from such diverse disciplinary backgrounds meant exposure to a range of new terms and concepts. Some of this new language also featured in our attempts to research and document our shared transdisciplinary practice, including terms like reflexivity, mutual learning, systems thinking, boundary objects, and safe-to-fail experiments. Alex noted that “I came in with a fairly narrow idea of interdisciplinarity as bringing people with different disciplinary expertise together, but I hadn’t engaged with transdisciplinary concepts like reflexivity at all—that was new to me.” For Jacqueline, being able to find the

language to describe BCII and answer the question “what do you do for a living?” was a “really big transformational moment.”

## **Q2: What have been our peak transformative learning moments?**

The second discussion question shifted the focus from how we had been transformed to when this occurred and in what context. Some of these moments were touched on in the responses to Question 1, such as Bem’s early experiences in curriculum design as the inaugural Course Director, Lucy co-coordinating a subject for the first time after transitioning from student to teacher, and Jacqueline’s moment of transformation upon being able to find the words to describe what she did for a living. The “first kiss” with BCII was viewed by all the participants as a key moment, with other responses focusing on times when they started coming together for research as well as teaching, when they branched out into new contexts, and when the COVID-19 pandemic hit.

While each participant had their own story of joining TD School and the “rapid learning curve” they underwent, Bem was able to reflect on what this was like at the very beginning of BCII:

There’s nothing quite as memorable as that first time we ran an intensive BCII subject in 2014. Our first team of academics who had helped create the BCII were simultaneously trepidatious and excited, watching the story that we had created unfold with unimaginable enthusiasm because we saw the impact of it almost immediately. The peak transformative energy in the room was palpable.

Giedre and Alex reflected on the transformative power of coming together with the aim of collaborating on research into transdisciplinary education practice rather than on the teaching delivery and curriculum design that had driven previous collaborations. For Giedre, this was about moving “from implicit practice to much more explicit understanding” driven by an openness to sharing and learning from one another. For Alex, this process “really made me reflect on the fact that we are all from different disciplines and there’s a whole history and baggage in terms of assumptions and language that comes from that.”

Lucy reflected on the transformative power of stepping outside of one's usual context, in this case by participating in a project that involved working with high school teachers to deliver the kinds of transdisciplinary learning activities that are applied in the BCII and evaluating the outcomes. Jacqueline also reflected on this experience, noting that "I had a conversation with a school at the end of our project where we were looking at the impact that we've had on the school. It's one of those recordings I will always keep because I never have more confidence in my ability than after hearing the type of impact and transformation we'd had on their ecosystem." For Bem, a key shift in context was running a BCII school overseas in Auroville, India and the way this challenged notions of "individualism, ego, and the sense that we are separate from the world."

The rapid pivot to online learning as the COVID-19 pandemic arrived was a key transformative moment for all participants in the reflection circle. BCII subjects had always run in person up until this point, and the shift to online learning came as some subjects were just commencing. For Susie, this raised complex questions such as "How do you support meaningful collaboration and teamwork if it's completely online? How do you run a sensory workshop focused on smelling and have multisensory dimensions that are part of the experiential learning and embodied experiences that we're trying to embed in the transdisciplinary work we do?" Factors that enabled this transformation were being able to rapidly bounce ideas around with colleagues, as well as a sense of playfulness and openness to experimentation.

### **Q3: What helped or enabled us to transform (processes, conditions, etc.)?**

The third question completed the shift from *how* we had changed and *when* it had happened to *what* enabled these transformations to occur. Key themes in our responses include institutional support, staff cultures and individual mentalities, and the value placed on learning from and conducting research into what we do.

"From a systems perspective," Lucy noted, "the university's support for transdisciplinarity is core for any of these moments of transformation to take place, in terms of resourcing, structure, leadership." Bem noted that, in relation to the BCII, "If it wasn't for our Deputy Vice Chancellor Education coming up with this idea and supporting it at the highest level, we would not

have been able to work across the faculty fiefdoms that exist in every university.” Jacqueline and Susie cited specific support structures that had enabled their growth, including the school’s Industry Partnerships Team, onboarding processes when they first started, administrative support in TD School, and communities of practice such as the First and Further Year Experience (FFYE) program at UTS.

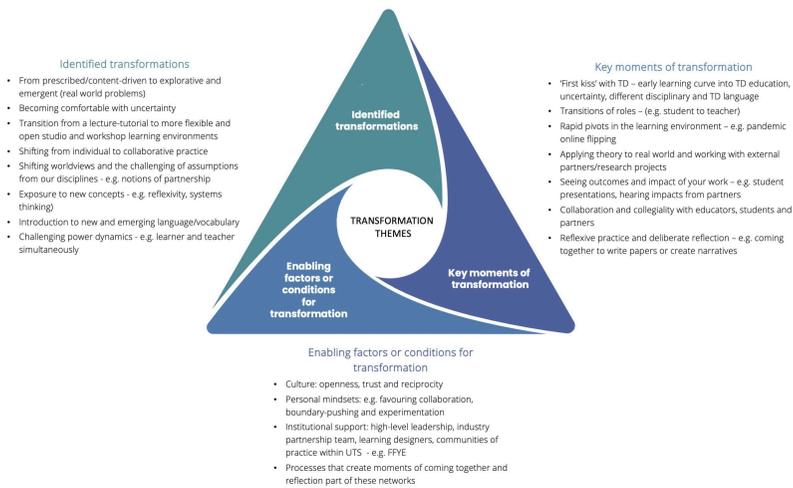
In terms of staff culture, key elements that were mentioned included sharing, openness, generosity, reciprocity, experimentation, playfulness, trust, respect, and care. One point of discussion was around the extent to which these were individual characteristics of the people who helped form TD School and the extent to which they were enabled as a culture. Bem highlighted the importance of the individual decision to stretch oneself: “I think everyone in TD school on some level, from the minute they join us, decides to start stretching themselves, often beyond their comfort zones.” Alex discussed how the diversity of people in TD School fed into this culture, noting how he had been struck by how many creative people there were in TD School, “which I wasn’t used to coming from science and social science faculties.” Giedre highlighted how a culture of experimentation had been enabled because “we’ve been given the space to create—if you have an idea, you just go ahead and do it, and nobody’s there to stop you from experimenting.”

The final theme discussed in the reflection circle was the way that having explicit spaces and processes for reflection on our teaching and learning practice had been a key enabler for transformation. Susie argued that “an enabling dimension for transformation is having those spaces to reflect, along with the role and power of narrative to support bringing in new people and having questions or assumptions spoken about from different viewpoints.” Alex highlighted the importance of having “a belief that what we’re doing is groundbreaking and creates new knowledge that is worthy of research.” As someone who had made the transition from student to teacher, Lucy felt that “something that’s very unique about TD School and our little corner of academia is that someone who is so new to this space can be included in those research opportunities.”

## Discussion

[Figure 1](#) summarizes the major themes arising from the reflection circle, divided into the kinds of transformations experienced, the moments at which they occurred, and the factors that enabled them. Several of the transformations that were cited related to challenging previous assumptions about how to structure learning activities, including a move away from lecture-style content delivery and toward project-based learning with uncertain emergent outcomes and high levels of staff collaboration. Other transformations related to new concepts and language and shifting power dynamics. The challenging of previous assumptions and worldviews was central to many of these transformations.

Key moments in which teacher transformations were observed included the initial entry into a transdisciplinary teaching environment, as well as transitions and pivots such as changing roles and responding to the COVID-19 pandemic. Other moments were less reactive and involved deliberate reflexive processes to come together and make sense of shared experiences. The enabling factors for transformative learning were seen to operate at a variety of levels, including personal traits (e.g., around collaboration, boundary pushing, and experimentation), school culture (e.g., openness, trust, and reciprocity), and higher-level institutional support that provided resources and enabled risk-taking.



**Figure 1:** Key themes emerging from the reflection circle. [See Appendix for a description of this image.](#)

Many of the transformative moments cited in our discussion featured an element of feeling “unsettled” before things began to make sense and the new learnings were able to be incorporated into our practice. Mezirow (1991) contends that “disorienting dilemmas” of this nature can act as enablers of transformative learning by encouraging self-examination and assessment of one’s prior assumptions. However, for transformative learning to happen in a collective manner, particularly amongst academics from diverse disciplinary backgrounds, it is important that a supportive social context exists in which these disorienting dilemmas can be examined and prior assumptions can be questioned and explored (Kligyte, 2011).

Liminality was a common feature in many of the transformative moments cited, including a sense that TD School academics occupy a space in between their disciplinary and transdisciplinary worlds. This liminality was also evident in the discussion of transitions, such as from student to teacher and back to learner again. However, to effectively enable transformative learning, it is important that participants are not simply left feeling disoriented and “betwixt and between” but rather that they are provided with safe and supportive transitional spaces in which to undertake self-examination, share their experiences with others, and reintegrate their learning into practice (Bentz & O’Brien, 2019). Transformation does not simply happen through collaboration on teaching tasks (Kligyte et al., 2021). Mezirow (1991) also high-

lights the importance of participants being able to see that others are also experiencing, or have experienced, what they are going through.

The environments in which TD School teaching staff interact with students, partners, professional staff, and other academics often have the characteristics of “third spaces” in which new ways of doing things are encouraged and existing power dynamics can be challenged (Kligyte et al., 2019). This includes the physical studio-based learning environments as well as the relational spaces created through the diverse ways in which students, teachers, and partners interact with one another. Breaking down the traditional “teacher-student” dichotomy can also enable mutual learning, in which all participants are open to learning and have something new to offer one another (Polk & Knutsson, 2008). Schnitzler (2020) emphasizes the importance of these “collaborative learning spaces” for enabling transformative learning.

The collaborative third spaces in BCII have emerged partly by design (e.g., studio-based learning focused on external partner challenges) and partly through the cultural norms of openness, trust, and experimentation cited in our reflections. “Trustful communication” has been cited as a key success factor for transformative learning (Schnitzler, 2020), as has a culture of active experimentation (Bentz & O’Brien, 2019). It is likely that the pre-existing traits of the people who came into TD School contributed to these cultural norms, as did the necessity of collaborating when doing something so new and different. However, it is also likely that reinforcing feedback has played a role (e.g., positive experiences around sharing led to greater trust and openness). Similarly, it is conceivable that different early experiences around sharing and collaboration would have generated different feedback and led to a different school culture today. Supportive external environments have also helped, such as the opportunity to tap into existing communities of practice for teaching at UTS and beyond.

Aside from the creation of a safe and supportive enabling environment for transformative learning, it is also important to employ “consciously directed processes” that enable the critical analysis and reflection necessary to transform one’s own assumptions and worldviews (Elias, 1997). Given that reflexivity is a central principle of TD practice (Polk, 2015), deliberate attempts have been made in TD School to pause and reflect on what staff have learned and to compare our experiences and perspectives coming from different disciplinary backgrounds. This has commonly taken the form of research projects, including on student-staff partnerships (Baumber et al., 2020); the creation

of third spaces (Kligyte et al., 2019); pandemic responses (Baumber et al., 2021); and the design of new teaching programs (Kligyte et al., 2022). Reflexive practice has also been incorporated into team building sessions and the onboarding of new staff.

Reflexive practice informs our work and anticipated future needs and aspirations. In the wake of recent bushfires, floods, and the COVID-19 pandemic, there have been significant externally driven transformations to our university and the higher education sector in Australia. During the transition back to face-to-face study after COVID-19 lockdowns, the insights from online learning were integrated with face-to-face practice at TD School to establish a new technology-enhanced transdisciplinary student learning experience (Melvold et al., in press). In the coming years, challenges posed by climate change are likely to require further transdisciplinary engagement and transformative learning involving staff members, students, and external partners as part of a broader UTS commitment to becoming carbon neutral and moving investment to a fossil free fund. We also anticipate that reflexive mutual learning centered around anti-colonial practices and Indigenous knowledges will further transform our practice with the implementation of the Indigenous Graduate Attribute into all UTS degrees, including BCII (Bodkin-Andrews et al., 2019).

Building on the success of the BCII, the impact and reach of UTS transdisciplinary education are growing. In 2022, UTS began implementing a Transdisciplinary Electives Program, whereby every undergraduate student at UTS will undertake a TD elective as part of their core degree, with transdisciplinary capabilities being seen as a key component of UTS graduate distinctiveness in the workplace. TD School is often contacted by other universities and institutions to understand how BCII was developed. We are also working with universities overseas to implement the BCII model in other contexts, extending the impact of our learnings internationally.

## Conclusion

Transdisciplinary approaches to higher education have been shown to enhance student learning through exposure to diverse perspectives, real-world challenges, and critical analysis of prevailing norms and assumptions about the world (Evans, 2015; Hudson, 2016; Fam et al., 2020). This study

shows that learning in transdisciplinary programs is not limited to students. Teaching staff can also learn and be transformed by what they learn in the process of designing and teaching these programs.

Experiences at UTS' TD School show that transdisciplinary teachers undergo diverse transformations, including in relation to how they conceptualize teaching, the ways they work together, the language and concepts they use, and the assumptions they bring with them from their "home" disciplines. These transformations have the potential to make them both better teachers and better learners, but they cannot be expected to simply happen without the right enabling conditions and processes. While each context is different, we suggest the following action items that others may wish to consider:

- Ensure strong institutional support, including adequate staffing and resources and the removal of structural barriers to transdisciplinarity within university systems. This may include establishing dedicated roles to support the delivery of transdisciplinary programs, offering onboarding programs to support staff transitioning into transdisciplinary learning environments, and creating opportunities for cross-faculty collaboration.
- Create an environment of trustful collaboration and a culture of openness and experimentation by hiring people who share this mindset, respecting their ideas, challenging assumed roles and hierarchies, and showing that it is safe to fail and feel "unsettled" at times.
- Employ deliberate reflexive processes such as reflection circles and writing from one's disciplinary perspective to help staff generate insights and make sense of what they are experiencing.
- Target support and reflection around key moments where transformative learning may occur, such as the "first kiss" with transdisciplinary teaching, changes in team composition, shifts in context, rapid pivots, and times when staff are changing roles.

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## Appendix: Image Long Description

### Figure 1:

The three transformation themes are as follows:

Identified transformations: from prescribed/content-driven to explorative and emergent (real world problems); becoming comfortable with uncertainty; transition from a lecture-tutorial to more flexible and open studio and workshop learning environments; shifting from individual to collaborative practice; shifting worldviews and the challenging of assumptions from our disciplines (e.g., notions of partnership); exposure to new concepts (e.g., reflexivity, systems thinking); introduction to new and emerging language/vocabulary; challenging power dynamics (e.g., learner and teacher simultaneously).

Enabling factors or conditions for transformation: culture (openness, trust, and reciprocity); personal mindsets (e.g., favoring collaboration, boundary pushing, and experimentation); institutional support (high-level leadership, industry partnership team, learning designers, communities of practice within UTS, e.g., FFYE); processes that create moments of coming together and reflection part of these networks.

Key moments of transformation: “First kiss” with TD—early learning curve into TD education, uncertainty, different disciplinary and TD language; transitions of roles—e.g., student to teacher; rapid pivots in the learning environment—e.g., pandemic online flipping; applying theory to real world and working with external partners/research projects; seeing outcomes and impact of your work—e.g., student presentations, hearing impacts from partners; collaboration and collegiality with educators, students, and partners; reflexive practice and deliberate reflection—e.g., coming together to write papers or create narratives.

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# 8. Effective Transdisciplinary Teaching Teams

## *Professorial Perspectives on Collaboration and the Circular Model for Collegiate Co-Teaching*

ANNE-LISE K. VELEZ; RALPH P. HALL; STEPHANIE N. LEWIS; ZACHARY UNDERWOOD; AND DARON WILLIAMS

The learning environment for the team teaching approach documented here is a collection of topic-specific course sections that run in parallel under a shared policy theme. This “SuperStudio” employs a co-taught, concurrent, corequisite structure that combines elements of design studio pedagogies, public affairs perspectives, and learning outcomes from capstone courses with transdisciplinary approaches to collaboratively identifying and describing “wicked problems” and potential solutions (Velez et al., 2021). The class meets three days a week for four credits, and students are expected to work in teams composed of peers from multiple topic sections with the goal of developing a document or prototype addressing a group-identified aspect of the policy theme. Faculty members are from varied disciplinary backgrounds, engage in transdisciplinary research in different areas, and each attend every weekly planning meeting and every course meeting in a truly integrated and collaborative approach to teaching. Over time our team has grown iteratively and organically, and we have developed means of communication and trust that contribute to the success of the team and the SuperStudio course. The course was developed in part to meet institutional goals around transdisciplinarity put forth as part of the 2047 visioning exercise “Beyond Boundaries,” intended to guide the direction of Virginia Tech as it navigates toward its 175<sup>th</sup> anniversary. Beyond Boundaries uses an institutionally adapted version of the “T-shaped learning” model that emphasizes the importance of students gaining disciplinary depth as well as interdisciplinary skills (Blieszner et al., 2015).

Because of this, the university has spearheaded several institutional initiatives over the last several decades. These include an early investment in interdisciplinary studies through initiatives such as the now reimagined

Center for Disciplinary Studies (Virginia Tech, 2002)—which, in the early 2000s, housed religious, Black, and women’s studies majors as well as an interdisciplinary studies major, humanities programs, and a humanities, science, and technology program—and through development of interdisciplinary graduate programs starting in 2015 to “develop the four pillars of the Transformative Graduate Education Experience: Knowledge, Leadership, Scholarly Inquiry and Social Responsibility” (Virginia Tech, 2024a) at both the master’s and doctoral levels. There have also been institutional efforts aimed at faculty, with the Provost’s Office’s “Destination Areas” encouraging faculty to engage in collaborative transdisciplinary work in both research and in teaching “to address complex problems that impact the human condition” and “address challenges in rural health, infectious disease, coastal mitigation, brain health and development, and security” (Virginia Tech, 2024b).

Institutional support for such efforts, both conceptually and financially, has been one key to our success, as it was for the University of Technology Sydney’s bachelor’s degree detailed in Chapter 7. However, as discussed by Sadre-Orafai and Tate in Chapter 6, grand challenges such as those mentioned above created opportunities for transdisciplinary initiatives even as other institutional structures and broader norms restricted such efforts. Further, given the relatively new focus on transdisciplinarity, there were no clear institutional assumptions about how it should be advanced, giving faculty the freedom to explore this emergent space.

Collaborative teaching, or co-teaching, can take many forms and is heavily influenced by factors such as team composition, course goals, and group dynamics. Many team teaching approaches are dyadic or focus on the delivery of discipline-based content (e.g., Cook & Friend, 1995; Shibley, 2006; Betencourt & Weldon 2010; Morelock et al., 2017). Courses with a real-world, wicked-problem focus benefit from instruction teams composed of differing expertise and serve as models of appropriate transdisciplinary collaboration techniques (Meizlish & Anderson, 2018). Here, we consider our team dynamics and experiences with collaborative rather than rotational (i.e., “tag team”) instruction. The rules of engagement for the group include equal and collective participation in course design, lesson planning, content presentation, and assignment evaluation (e.g., Deighton, 1971; Sandholtz, 2000). This structure provides substantive collaborative instruction to students in one shared physical teaching space (e.g., Cook & Friend, 1995; Morelock et al., 2017) and facilitates an experience that a single instructor could not create (Wenzlaff et al., 2002).

The importance of trust to collaboration and innovation is well known (Fawcett et al., 2012; Torfing, 2019), as is the process of stepwise and iterative group formation (e.g., Tuckman, 1965; Tuckman & Jensen, 1977). In our teaching team, we take an “interactive” approach as each member teaches either the entire class or small sections of students at one time (e.g., Walther-Thomas et al., 2000); provides leadership for the class and teaching assistants; shares constructive, perspective-based feedback with students; and cycles through grading all student project teams. This process necessitates verbal exchange and clear written records of feedback provided to students, both for us and for them. While teaching team membership has changed slightly over time, team composition and the need for close coordination means we have found trust built on honesty, communication, appreciation, and shared commitment to the learning goals to be key to our success. In the process of building and maintaining our teaching team, we have discovered many commonalities and noted some differences between our experiences and previous investigations of team teaching.

## What Do We Know About Teaching Teams?

**K-12 Settings.** In K-12 settings, co-teaching is fairly common, is frequently employed for special education inclusion (e.g., Kloo & Zigmond, 2008) and English language learners (e.g., Honigsfeld & Dove, 2016), and often relies on a content area expert familiar with the developmental needs of the target population. In higher education, the practice of co-teaching is less common but is employed for training graduate students as instructors (e.g., Walters & Misra 2013; Gladstone-Brown, 2018). Many studies of co-teaching in higher education rely on teacher pairings (e.g., Perry & Stewart, 2005) that fall within a discipline (e.g., Bettencourt & Weldon, 2010). Through research extending over the past fifty years, dynamics of these dyadic team teaching relationships in both K-12 and higher education have been closely examined and are substantively understood; managing power dynamics registers as a key component of success in many of these pairings (e.g., Morelock et al., 2017; Minett-Smith & Davis, 2020) with one study noting that in co-teaching dyads neither teacher “has proven eager to give up leading their lesson when a co-teacher is present” and that trust is foundational to having a willingness to do so (Honigsfeld & Dove, 2016, p. 58). Studies have also examined

some aspects of interdisciplinary perspectives in team teaching (e.g., Bowles, 1994; Perry & Stewart, 2005), including some focused on finding “key cross-disciplinary connections” in topics that represent problems clearly outside of disciplinary boundaries (e.g., Krometis et al., 2011). However, a clear interrogation of differences between dyadic disciplinary teams and interdisciplinary or transdisciplinary teaching teams comprising several members is lacking from the literature. Such differences, though hidden from pedagogical discourse, have clear implications for both institutional supports for these types of teaching teams and for individual instructors seeking to form and maintain such teaching teams.

When considering changes in curriculum or transitions in delivery modes in K-12 educational settings, Vostal et al. (2019) note that “relational trust” is important as “the degree of trust within a school’s culture has been shown to significantly predict whether collaborative practices (e.g., professional learning communities) can significantly improve student outcomes as demonstrated by ... (Bryk & Schneider, 2002; Forsyth et al., 2006)” (p. 88). Relational trust is built on repeated interactions over time. They note that leadership can encourage such trust by building opportunities for K-12 faculty to interact with one another in low-stakes situations like socializing over lunch—people will start to build familiarity and trust, and you can then get people to work together on committees, in which eventually they may trust each other enough to co-teach successfully. Shared teaching philosophies, teaching the same grade, or equivalent teaching tenure with colleagues tend to build “perceptions of kinship” that help bolster collegial trust relationships in this context. Vostal et al. (2019) specify that this type of collegial trust building is specific to K-12 and to co-teaching partnerships that are not emergent or autonomous but rather dictated by the needs or structure of the school.

**University Context.** This stands in direct contrast to the process of developing and delivering new courses and curricula at the university level, where it is far less likely to be top-down and where faculty can have marked autonomy over what they teach as well as the content, design specifics, delivery style, learning objectives, and application of skills and knowledge. This environment is also shaped by teaching workload and assessment requirements/systems that make collaborative teaching harder to account for and potentially a high-risk venture for faculty considering promotion and tenure. These institutional factors could explain an instructor’s desire to retain control over class instruction and reinforce the critical role of trust in advancing

new, collaborative models of instruction. There is also a lack of research on the value/impact of collegiate co-teaching relationships, with most research about successful co-teaching focused on K-12 teachers demonstrating that “successful co-teaching experiences depend on partners’ ongoing relationships with one another” (Morelock et al., 2017, p. 182).

Earlier co-teaching literature (LaFauci & Richter, 1970; Austin & Baldwin, 1991) suggested division of collegiate teaching responsibilities in contrast to collaborating to deliver instruction. More recent studies on co-teaching show positive outcomes for instructors in learning content and pedagogy from one another, more student interaction, and less isolation (e.g., Krometis et al., 2011; Bettencourt & Weldon, 2010; Bowles, 1994), but also arguably negative outcomes in experiencing “less classroom autonomy and an increased workload” (Morelock et al., 2017, p. 183) than with traditional individual teaching arrangements. Some studies have found that “concerns” related to co-teaching outweigh advantages in some disciplinary pairings (e.g., Bettencourt & Weldon, 2010). This makes clear that collegiate co-teaching offers both challenges and benefits for involved instructors but that relationships should be carefully cultivated and maintained. Honigsfeld and Dove (2016) note three consistent elements of successful teaching dyads are trust, collaboration over the whole instructional cycle, and leadership support. Collaborating over the instructional cycle means that co-planning, co-teaching, co-assessment, and reflection must be done in partnership.

Even when the focus is on interdisciplinary teaching teams, the “teams” are often dyadic (e.g., Bowles, 1994; Shibley, 2006)—but there are still slightly different lessons to be learned than when instructors are from a single disciplinary background. For example, Shibley (2006) notes that one of the main issues that presents itself in such teaching relationships is the need to recognize, negotiate, and reconcile differences in pedagogy based on disciplinary conventions, in part through laying out clear learning objectives (e.g., Davis, 1995). Shibley asserts that these differences in pedagogical approaches are so important that in his case studies “the success of the course seemed to depend on how well the collaborators were able to negotiate pedagogical differences during the planning stages” (p. 272). Perry and Stewart (2005) identify “key elements for effective partnership in interdisciplinary team teaching” based on analysis of interview data from fourteen team teachers and conclude that compatibility of experience, personality and working style, and beliefs about learning are particularly important to co-teaching success. Similarly, Shapiro and Dempsey (2008) identify the potential for

“conflict arising from interdependency” in interdisciplinary teaching teams as “identity, relationship, and process” are negotiated. The negotiation process, and subsequent relationship building, are influenced by the roles and approach to content delivery designated by the team: lead instructor versus co-facilitation and coordinated sections versus rotational instruction (Meizlish & Anderson, 2018, p. 3). Co-teaching models that are structured to counteract known points of conflict, while considering the instruction process from the beginning, are considered to foster the elements of trust between the team members necessary for successful course outcomes.

**A Circular Model of Collegiate Co-Teaching.** A particularly insightful investigation of collegiate co-teaching was undertaken by Morelock et al. (2017), who developed the Circular Model of Collegiate Co-Teaching (Morelock et al., 2017, p. 185) to address the gap in understanding of collegiate co-teaching relationships using interviews with seven college-level educators with recent dyadic teaching experience. The model Morelock et al. (2017) developed comprises “three interrelated themes” of “power and authority structures, dynamics of co-teaching relationships, and co-teachers’ perceptions of the advantages of co-teaching, disadvantages of co-teaching, and student experiences” (p. 184).

Power and authority structures include course ownership, for example, which instructor “controlled important decisions” like “course objectives and pedagogy” (p. 194); academic hierarchy or seniority; and institutional support, especially in relation to credit given for co-teaching compared to traditional solo teaching. Dynamics of co-teaching include modes of collaboration like dividing classes for individual lesson development or being “active in each class session” and collaborating on goals and content; habits of communication, including “relationships that extended beyond the classroom” to research or friendship; and mentoring and co-learning between instructors from co-teaching, which is also well-documented elsewhere. Co-teachers’ perceptions include those of student experiences in co-taught courses; perceived advantages of co-teaching including more perspectives and expertise, teaching skills, and flexibility; and perceived disadvantages include time required, effort acknowledged, and tensions in course decision-making.

For Morelock et al. (2017), the model is circular because each area affects the next. For example, power and authority structures experienced by instructors inform the way they structure co-teaching dynamics, which in turn then modify or reinforce those existing power and authority structures. Meanwhile, co-teaching dynamics also influence perceptions of co-teaching,

which in turn “further modified or reinforced power and authority structures” (p. 188). Many elements of this dyadic disciplinary model resonate with our team teaching experiences, and we use it as the basis for modeling dynamics of interdisciplinary teaching teams with several members. However, we argue Morelock et al.’s (2017) model is representative of co-teaching that is cooperative and coordinated but not of transdisciplinary collaborative teaching. The Circular Model “encompasses all configurations in which two individuals collaborate in the design and execution of a course section” (p. 182) where power and authority structures are key elements. The interdisciplinary nature of our teaching team, which includes a larger group (4–6 members), and the transdisciplinary focus of the course excludes power from the equation. The authority structure in the form of institutional support remains, working as an antecedent condition as much as an influencing factor. This is discussed further below.

## SuperStudio Course Structure and Benefits

The structure and specifics of the transdisciplinary SuperStudio course are outlined elsewhere (Velez et al., 2021), but a brief introduction is necessary to properly understand the demands put on the team, both in terms of time and dedication to student outcomes. Borrowing from Nicolescu (2002), Appel and Kim-Appel (2018) note “the space between disciplines and beyond disciplines is full of information” (p. 62). We also see a preference by employers for hiring graduates who can successfully work beyond a single discipline (Hart Research Associates, 2018). Taken together, courses that focus on wicked problems that are larger than any disciplinary perspective and courses that combine instructors with multiple disciplinary and interdisciplinary perspectives provide a particularly fruitful context in which students learn required professional skills and team teaching dynamics can be explored. The type of transformations faculty experience in these spaces are further detailed in Chapter 7 by Baumber et al. In the SuperStudio, “students practice transdisciplinarity within the context of an innovative course structure combining concurrently taught sections, collaborative learning and instruction, and co-requisite course enrollment” in a three-credit topic section with a corequisite one-credit policy context course (Velez et al., 2021). As for others, like O’Sullivan in Chapter 2, environmental policy has proven an appro-

priate area on which to focus transdisciplinary pedagogy initiatives. Initial offerings of the SuperStudio course focused on Green New Deal proposals for the policy context, with recent offerings using a Climate and Community theme and the Inflation Reduction Act of 2022. Students in the course come from degree programs across the university—they might be environmental policy and planning or smart and sustainable cities majors completing their degree with the SuperStudio serving as their capstone course, or honors students from any major working toward their honors minor or taking the course as an elective for credit toward their Honors Laureate Diploma.

The four credit hours of the course meet across three days, with two seventy-five-minute and one fifty-minute class session each week, and all members of the teaching team attend all three class sessions weekly. Team members lead different activities depending on expertise, experience, and desire; some activities are led by a single person with instructor support for group activities, but many are co-led with rotations in leadership as we all work together to design activities and assignments. The goal is collective familiarity that aligns with expectations and objectives. Because all the instructors have different areas of expertise, and the focus of the course is on wicked problems that involve all our expertise, there is no consistent hierarchy among the team members in relation to planning, delivery, or student evaluation. This structure increases the time and effort put into the course, but it also increases the time spent working with each other and, therefore, the cohesiveness of the team.

In addition to the differences in structure compared to traditional university courses, the experience and, therefore, benefits for instructors and for students are different as well. Trust among the instructors means that we have constant access to peer feedback about how to improve our own teaching in terms of content, delivery, and communication with students—rather than having to wait for the one day a year when a colleague might observe a class and provide us feedback with very little context about the content or students. When we face dilemmas about how to adjust the course or deal with providing support to students in the face of a difficult situation or clarifying expectations with students who may be less than fully engaged, we have trusted colleagues with whom we discuss the situation to make sure we are considering as many points as possible and that we are in agreement. Just as students are able to identify a project and work on it with a team of friends or students with whom they build trust over a semester, we have been able to develop an ongoing relationship and friendship and are able

to work on our project of how best to approach collaborative transdisciplinary team teaching over a number of years. Each time we teach we are able to make adjustments and aim for an even more successful iteration of the course than the time before.

For students, the experience is quite different from most college courses both in terms of structure and project scope. A story in our institution's university news (Warnick, 2022) shared perspectives from a few students. Senior environmental policy and planning student Kayleigh Steigman “worked on a project to reskill coal industry workers and thus hasten the shift from fossil fuel to renewable energy” and shared that the multiple sections are informative in that “it’s helpful to see how other sides would think about the issues.” Warnick described student experiences in the course by noting “by the end, most students struggled to remember which section of the course they’d originally signed up for, but they all loved how collaborative SuperStudio had become.” 2022 political science graduate Olivia Wolz described the course as being “a different way to learn ... more interactive than most classes. You’re not expected to sit and listen to a lecture, you’re expected to do things.”

In addition to student experiences in the course and initial reactions to and feedback from these experiences, we try to help students to preserve their access to the products of these experiences as much as possible. We ask them to engage in structured reflection exercises at the close of the course and encourage them to submit permission for their team semester projects to be added to the library database, creating permanent web access to their documents that can then be linked to resumes or portfolios. Sometimes, unexpected opportunities come out of the course. For example, we have had student projects with outside groups turn into summer internship opportunities and have heard back from graduates that their experiences in SuperStudio related to an ability to talk about complex problems and how to collaborate across boundaries during job interviews—after which they were offered the job. We have also heard from students about ways in which the course influenced their future direction. Elizabeth Quill, MPA communicated to us “in part the reason I went into the VT [Virginia Tech] MPA program was from learning more about policy processes in my senior capstone and Honors-SPIA SuperStudio seminar and realizing policy is the way I wanted to live out [the university motto] *Ut Prosim* [meaning “That I may serve”] and serve my community.”

# Teaching Team Structure, Formation, and Maintenance

**Background of Instructors.** While each of the current team members has different disciplinary backgrounds, we are also ourselves not disciplinary purists—between us, we possess graduate degrees in engineering; technology, management, and policy; genetics, bioinformatics, and computational biology; communication; educational media; higher education administration; learning technologies; architecture; and public administration. Apart from our transdisciplinary teaching, we each occupy positions and focus on research agendas that require us to translate between and across contexts. Outside of the SuperStudio, we each largely engage in work that “seeks to assemble new approaches from scratch” (Bernstein, 2015), regularly blurring or crossing traditional disciplinary boundaries in our approaches to both teaching and research without preconceived structuring of transdisciplinarity.

As with other teaching teams (e.g., Shibley, 2006), our initial iterations of the SuperStudio were based on smaller, established partnerships that took place against an institutional backdrop of conversations about experiential learning, creative pedagogies, and transdisciplinarity. With the exception of two members, the group had not connected beyond general professional acquaintances before working as a team. Two members worked together for only a year before initial ideas for the course were discussed. In spring 2019, conversations about universal themes present in seemingly disparate individually taught topics courses led to the scheduling of topics courses at the same time in adjoining classrooms, allowing for the development of shared class meetings focusing on issues such as ethics, equity, and problem framing. The joined-class sessions concept-initiated conversations between faculty and administrators in multiple spaces on campus. As these conversations continued, additional faculty from different units were included in the conversations to see if there was interest in developing a course offering with a “wicked problem” as an umbrella topic. Interested faculty had previously taught for our unit or were familiar with our mission of “developing the integrative and reflective educational experiences that graduates will need as effective workers and citizens” (Virginia Tech Honors College, n.d.-a) “in a world that is on the cusp of economic and civic revolution” (Virginia Tech

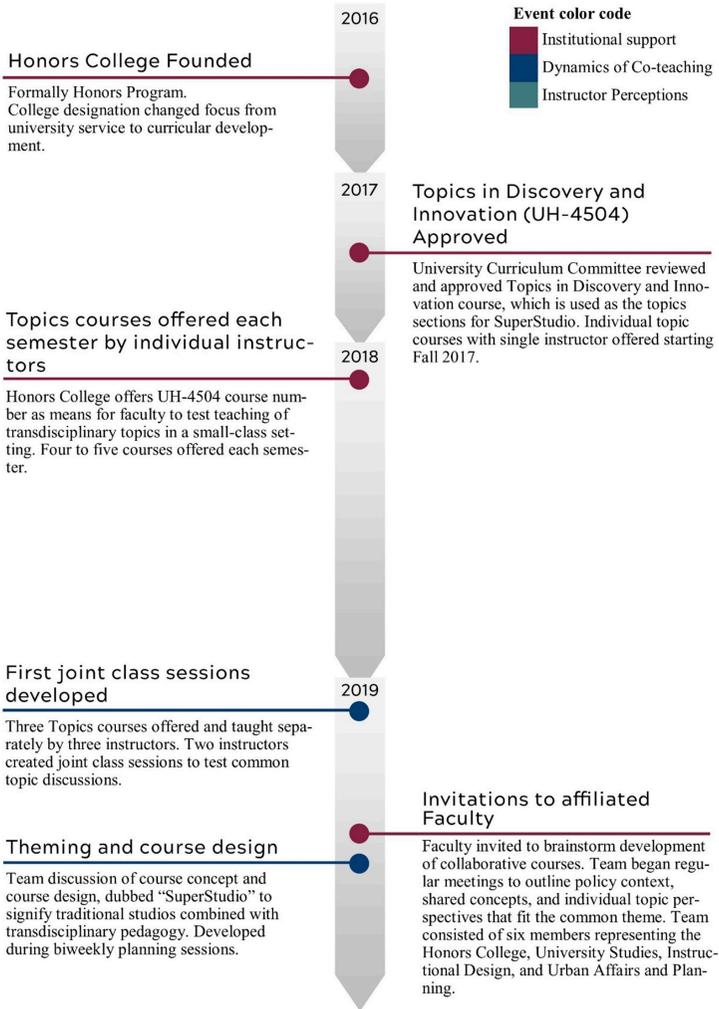
Honors College, n.d.-b). The initial idea exchange served as a way to determine who would be a good fit for the team and course goals. Course planning started and has gone through several iterations since the first offering of the SuperStudio in spring 2020 ([see figure 1](#)).

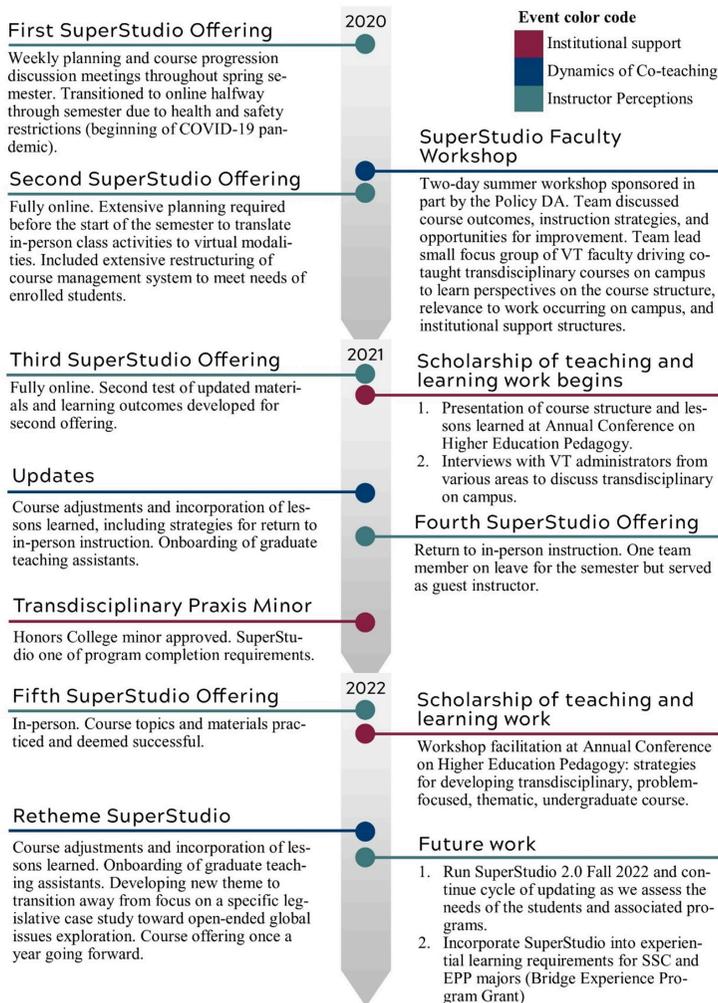
**Establishing Team Dynamics.** At present, apart from the multiple disciplinary lenses, the group comprises associate and assistant faculty and instructional staff, unit and sub-unit administrators, and PhDs both in-process and awarded as long as sixteen years ago. Everyone on the team has engaged in numerous types and levels of pedagogical training and has experience teaching in a variety of modalities (e.g., undergraduate and graduate courses, professional workshops). While much of the literature focuses on interdisciplinary learning and instruction, the size of our team and the focus of the course push us closer to transdisciplinarity: a collection of seemingly disconnected experts making connections between knowledge arenas in order to create a new approach to analyzing and proposing solutions to ambiguous, complex problems with significant social impact.

Our discussions ensure consistent communication with the students as well as between the teaching team and teaching assistants (TAs), who have ideally taken the SuperStudio as an undergraduate. In addition to these regularly scheduled and formalized meetings, we are friends. We meet for coffee to talk about work issues both involving and outside of SuperStudio, share anecdotes about family, and cheer on each other's personal and professional successes. We sometimes give each other advice about personal matters and serve as editors and advisors for each other on projects in which we are not directly involved. At the end of the semester, when possible, we meet for a meal while we debrief, and when not, we share homemade baked goods at a meeting.

The lack of existing relationships meant we had to learn to communicate well with one another to allow for honesty in our discussions that could build trust over time. But it also meant that in some ways we were obligated to work together—we had committed to building a very different type of course than any of us typically taught or is commonly seen at universities. We had to buy into the idea of success to give it a chance to work. We also had to collectively agree that development could be messy and would be iterative. The shared experience, bolstered by institutional support for the idea, gave us the academic freedom to establish goals for our learners, identify universal concepts, construct assignments, and establish a collaborative instruction framework where expertise can be highlighted. Initial differences in individ-

ual perceptions of co-teaching and occasional disagreements about course elements were deemed helpful in driving discussion, debate, and course innovation. The end goal was a course that everyone is comfortable teaching. The lack of history or expectations, which was a consequence of not knowing each other initially, allowed each of us to approach the project with a degree of openness, humility, and a lack of agenda which would perhaps have otherwise not have been possible. We found we were compatible in experience, personality, working style, and beliefs about learning (Perry & Stewart, 2005), enabling us to work together well. With repeated interactions, initially to develop the focus and direction of the course and then to develop course materials and assessment tools, we built relational trust that has withstood several years of interactions.





**Figure 1:** Timeline for development of the SuperStudio course and the transdisciplinary teaching team, 2016–2022. Color coding for the points associated with each event matches the color code used in the Circular Model of Co-Teaching for Collegiate Transdisciplinary Teams (figure 2), based on colors in Morelock et al. (2017). [See Appendix for a description of this image.](#)

**Working Through Adversity.** As seen in figure 1, a timeline of this iterative process details our activities starting with the initial institutional activities for course development and going through to the course offerings. We also include events after we started offering the class as we fall sharing our

course development approach to audiences of scholarship of teaching and learning through presentations and publications. As work is ongoing, both with internal details of the SuperStudio design and its relationship to various majors and minors at the university, the timeline includes future directions for the team.

For us, collective support among team members was especially important during the transition to online teaching early in the pandemic, which occurred halfway through our second offering of SuperStudio, and after the transition back to in-person teaching. During that time, we continued to communicate often and candidly, to collaborate closely on course adjustments and delivery, and to foster information exchange and ideation. As is clear in [figure 1](#), institutional support is key not only in the initial stages of such work, but throughout the iterative process and as perceptions and dynamics shift.

Unsurprisingly, this collaboration supports the well-established assertion that “team teaching is more time-consuming than teaching alone” (Davis, 1995, p. 115) and that successful interdisciplinary instruction is in large part dependent on “ample” time to develop the course (e.g., Krometis et al., 2011). Apart from the three class sessions each week that all five of us attend, we have a standing one-hour meeting each week prior to the week’s classes. During summers, we maintain meeting schedules when we are available. We are now transitioning to offering the SuperStudio with a new team in the fall semester rather than having our team teach during both semesters, but we will maintain weekly meetings in the fall to prepare and align assignments with current goals and learning objects as well as align the topic sections. During meetings we discuss the distribution of labor, task delegation, any issues that have come up with students or with grading, and address questions from the TAs. Trust in our co-teaching team also proves important in providing feedback to students because we are collectively evaluating and grading students who are technically assigned to specific sections of the SuperStudio—this means that individual student displeasure about the consistency and applicability of project feedback or perceived fairness of grading from one or more team members can lead to negative teaching evaluations for one or all members of the team.

**Reflection and Affirmations.** In addition to clear communication about course content and student needs, we each take care to reflect on individual and collective contributions (e.g., Bailey et al., 2001; Perry & Stewart, 2005) and give each other credit for contributions to the course. The latter

includes public credit when speaking to other faculty, communicating with administrators, and helping build connections for students by explaining that our feedback builds on some particular piece of feedback previously given by another faculty member. As part of this, we also take care to acknowledge what each of us has done among the group and to express our gratitude for the rest of the team. This does not mean we always agree with one another, but we are always honest in our opinions with one another. We have found this not only builds trust as a team, but our assignments are better, and we can clearly communicate to students the rationale behind decisions, as we have had to thoroughly discuss and defend them. This stands in contrast to decisions in an independent course or with dyadic team teaching in which power dynamics born of academic hierarchy or course ownership dictate that one team member should make the final decision without having to carefully defend the choice.

## Adapted Circular Model: Collegiate Transdisciplinary Co-Teaching

Morelock et al.'s Circular Model of Collegiate Co-Teaching comprises three elements: Power and Authority Structures, Co-Teacher Perceptions, and Dynamics of Co-Teaching. Our Circular Model of Co-Teaching for Collaborative Teams comprises four: Dynamics of Co-Teaching remains; Co-Teacher Perceptions is approached separately as Individual Perceptions; Collective Perceptions includes perceptions of student mentoring; and Power and Authority Structures is replaced by Institutional Support, with academic hierarchy and ownership of the course removed.

For our teaching team, the element of Power and Authority Structures is quite different than for Morelock et al.'s teaching dyads ([see figure 2](#)) and in our case is replaced by Institutional Support. The origin of the course within the Honors College, which is at the time of writing not classified as an academic college, removes academic hierarchy as an issue and the authority structure exists specifically in relation to institutional support that is antecedent to the collaboration. The multidisciplinary nature of the team and transdisciplinary nature of the material, as well as the collective instruction experience on which the other team members rely, contributes to egalitarian decision-making and truly collective ownership of the course. Funding, space, and

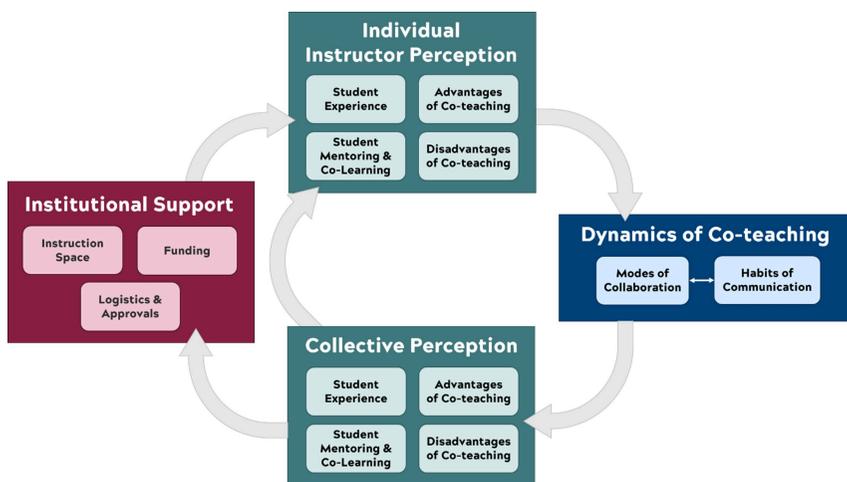
university approval processes are the limited influences of the institution in our case. Though smaller in impact, the institutional element of the model still yields some influence on individual perceptions of and willingness to engage in co-teaching and is influenced by collective perceptions of available institutional support (see figure 2). However, the academic and administrative roles of each team member may help address these constraints over time, as lessons learned from the SuperStudio can be communicated via the institution's shared governance processes. For example, team members serve on university commissions, departmental committees (including promotion and tenure committees), and run academic or administrative units. Sharing the story of how collaborative and transdisciplinary pedagogy can be advanced along with the challenges and opportunities may help ease institutional barriers for others looking to replicate elements of the SuperStudio model.

The dynamic of the team is also slightly different from the original model in that the group does not engage in formal mentoring between instructors, as there is no power and seniority structure in class, and instead engages more collaborative learning regarding pedagogical best practices. The group works together to identify relevant reading materials, collectively build course elements, and share the teaching process through genuine interest in the perspectives of others. When one person leads a class session, the rest of the group is capable of learning from that session and translating the ideas and terms to their subsequent sessions to help learners see the connections they should also make.

In our case, the mentoring element is heavily embedded in student learning and, therefore, reflected in the individual and collective perception elements of the model. The instructors work individually and collectively to mentor the students through problem-based, and occasionally project-based, learning. The students often explore problems and ideas that are outside of our existing expertise, which translates to elements of co-learning between the students and instructors. The students see modeling of the research process and are able to establish their autonomy and authority on the problem they identified.

While Morelock et al. (2017) distinguish between influence, inform, and modify or reinforce in their relational arrows, we do not distinguish between these three ideas and choose instead to depict them simply as directional links indicating influence and temporality, as is often standard in process models. In short, while Morelock et al.'s model well captures dynamics and

impressions related to co-teaching, for our multidisciplinary teaching team, we find the team teaching process lacking the element of power, with institutional support playing the role of the precursor condition to each iteration of a transdisciplinary course. Additionally, individual instructor's opinions and motivation are influenced by institutional support for the initiative. The perceptions of the individual impact how they communicate and collaborate with the team, which, in turn, influences the collective perception of the teaching experience and environment. The outcomes from the course, as reported by the teaching team, affect institutional perception and continued support of the course and continued participation of the individual instructors.



**Figure 2:** Circular Model of Transdisciplinary Co-Teaching for Collaborative Teams. [See Appendix for a description of this image.](#)

Elements of power and authority contributed by Morelock et al. (2017) are truncated to Institutional Support (red box). Perceptions of the instructors within the team (teal boxes) are included as both individual and collective perceptions of the learning and instructional experiences. The final influence is the team dynamics (blue box), which are based on instructor experiences prior to the partnership. Arrows represent the direction of influence of one element on another.

## Discussion

While some warn of the potential for conflict in highly interdependent teams such as ours in which subjects and pedagogies are integrated (e.g., Shapiro & Dempsey, 2008), we have not had this particular experience. We attribute this to our focus on communication and honesty, which has built an extremely strong foundation of trust among our team members. If a member of the team strongly opposes an idea or one of us finds the rest of the team is not receptive to an approach in a particular instance, we have strong enough trust in the team to be able to talk through the conflict in detail. Focus is placed on understanding disconnections from the contested idea and the motivation behind the sought-after adjustment based on alignment with course goals and student needs. There is no focus on power and authority or academic hierarchy or course ownership because the team has agreed that these are factors that should not directly influence the daily particulars of the course.

The size of the team presents advantages and disadvantages from the perspectives of both the instructors and the learners. Students may struggle with the number of instructors and understanding of how to approach the group with questions or concerns about the course. Instructors are required to balance their individual perceptions of the learning environment while also considering and supporting the decisions of the collective. Interpretations of issues and elements of the course can vary, which increases the significance of the communication element of the team dynamic. While not an extensive list of all the considerations for applying this adaptive model, these examples provide insight into conversations and situations experienced by the team over multiple iterations of the course, which included transitions from in-person instruction to online instruction and a return to in-person course delivery in short succession.

## Conclusion

Our experience contains lessons for both faculty and students engaging in collegiate co-teaching experiences. It underscores the need to actively demonstrate the instructor collaboration and teamwork that informs the

course and the work we ask students to do. This means finding a careful balance of letting students see the “sausage making” process so they can see teamwork while keeping some activities behind the scenes to reduce learner confusion. Just-in-time adjustments to the course are made based on student needs in response to their progress rather than concern or a lack of preparation on the teaching team’s part. The combination of co-learning between the instructors and students, the open and frequent communication, and the attenuated transparency fosters an environment of trust between the instructors and students.

For us, early commitment was key—while we found power dynamics to be mute, the aspect of team teaching discussed most with disciplinary dyads was trust. Honigfeld and Dove (2016) quote a teaching dyad participant as attributing co-teaching success as “result[ing from] trust, respect, and high expectations” (p. 56), and we have found that to be equally true for our transdisciplinary team.

While the adapted Circular Model for Collegiate Transdisciplinary Co-Teaching serves as a tool to visually summarize the connections between us as a team and our stakeholders, we believe the model serves as a starting point for conversations by others interested in pursuing transdisciplinary coursework that blurs disciplinary boundaries and includes experts from various fields. Importantly, our team was built fairly organically around a topic for our course focus rather than based on a conception of an ideal combination of disciplines from which to grow the course. Connections that we have made as a team have served our students in a way that could not be replicated using co-teaching models that limit the engagement of any members of the teaching team. We acknowledge that the details of the model, such as the specific advantages and disadvantages perceived by those on the team, will vary, but elements like the separation of power and authority from the course development process serve as lessons learned for improving team dynamic and instructor motivation. In our collaboration, we strive to focus on the connection we make between our disciplines and showing students how to do the same in their professional endeavors. Our model disrupts assumptions about co-teaching, especially around hierarchy and power stemming from concepts of a team lead or senior instructor, and it fosters transdisciplinary thinking with multiple levels of trust and autonomy from everyone involved.

# Acknowledgments

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# Appendix: Image Long Descriptions

## Figure 1:

- 2016 – Honors College founded (Institutional Support). Formally Honors Program. College designation changed focus from university service to curricular development.

- 2017 – Topics in Discovery and Innovation (UH-4504) approved (Institutional Support). University Curriculum Committee reviewed and approved Topics in Discovery and Innovation course, which is used as the topics sections for SuperStudio. Individual topic courses with single instructor offered starting fall 2017.
- 2018 – Topics courses offered each semester by individual instructors (Institutional Support). Honors College offers UH-4504 course number as means for faculty to test teaching of transdisciplinary topics in a small class setting. Four to five courses offered each semester.
- 2019 – First joint class sessions developed (Dynamics of Co-Teaching). Three Topics courses offered and taught separately by three instructors. Two instructors created joint class sessions to test common topic discussions.
- 2019 – Invitations to affiliated faculty (Institutional Support). Faculty invited to brainstorm development of collaborative courses. Team began regular meetings to outline policy context, shared concepts, and individual topic perspectives that fit the common theme. Team consisted of six members representing the Honors College, University Studies, Instructional Design, and Urban Affairs and Planning.
- 2019 – Theming and course design (Dynamics of Co-Teaching). Team discussion of course concept and course design, dubbed “SuperStudio” to signify traditional studios combined with transdisciplinary pedagogy. Developed during biweekly planning sessions.
- 2020 – First SuperStudio offering (Instructor Perceptions). Weekly planning and course progression discussion meetings throughout spring semester. Transitioned to online halfway through semester due to health and safety restrictions (beginning of COVID-19 pandemic).
- 2020 – SuperStudio faculty workshop (Dynamics of Co-Teaching). Two-day summer workshop sponsored in part by the Policy DA. Team discussed course outcomes, instruction strategies, and opportunities for improvement. Team lead small focus group of VT faculty driving co-taught transdisciplinary courses on campus to learn perspectives on the course structure, relevance to work occurring on campus, and institutional support structures.
- 2020 – Second SuperStudio offering (Instructor Perceptions). Fully online. Extensive planning required before the start of the semester to translate in-person class activities to virtual modalities. Included extensive restructuring of course management system to meet needs of

- enrolled students.
- 2021 – Third SuperStudio offering (Instructor Perceptions). Fully online. Second test of updated materials and learning outcomes developed for second offering.
  - 2021 – Scholarship of teaching and learning work begins (Institutional Support).
    - Presentation of course structure and lessons learned at Annual Conference on Higher Education Pedagogy.
    - Interviews with VT administrators from various areas to discuss transdisciplinarity on campus.
  - 2021 – Updates (Dynamics of Co-Teaching). Course adjustments and incorporation of lessons learned, including strategies for return to in-person instruction. Onboarding of graduate teaching assistants.
  - 2021 – Fourth SuperStudio offering (Instructor Perceptions). Return to in-person instruction. One team member on leave for the semester but served as guest instructor.
  - 2021 – Transdisciplinary praxis minor (Institutional Support). Honors College minor approved. SuperStudio one of program completion requirements.
  - 2022 – Fifth SuperStudio offering (Instructor Perceptions). In person. Course topics and materials practiced and deemed successful.
  - 2022 – Scholarship of teaching and learning work (Institutional Support). Workshop facilitation at Annual Conference on Higher Education Pedagogy: strategies for developing transdisciplinary, problem-focused, thematic undergraduate course.
  - 2022 – Retheme SuperStudio (Dynamics of Co-Teaching). Course adjustments and incorporation of lessons learned. Onboarding of graduate teaching assistants. Developing new theme to transition away from focus on a specific legislative case study toward open-ended global issues exploration. Course offering once a year going forward.
  - 2022 – Future work (Instructor Perceptions).
    - Run SuperStudio 2.0 fall 2022 and continue cycle of updating as we assess the needs of students and associated programs.
    - Incorporate SuperStudio into experiential learning requirements for SSC and EPP majors (Bridge Experience Program Grant).

[\(Return to text\)](#).

## Figure 2:

Institutional Support (includes instruction space, funding, logistics and approvals) leads to Individual Instructor Perception (includes student experience, advantages of co-teaching, student mentoring and co-learning, disadvantages of co-teaching). That leads to Dynamics of Co-Teaching (includes the interaction between modes of collaboration and habits of communication), which leads to Collective Perception (includes student experience, advantages of co-teaching, student mentoring and learning, disadvantages of co-teaching). This leads back into either Institutional Support or Individual Instructor Perception.

[\(Return to text\)](#).

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### **Transdisciplinary, Challenge-Based Education Design Using Knowledge Creating Teams from Five European Universities: A Case Study**

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## Evaluating and Scaling Best Practices in Interdisciplinary, Project-Based Learning

**Edward J. Balleisen** is Professor of History and Public Policy and Vice Provost for Interdisciplinary Studies at Duke University. He works with a suite of university-wide institutes and centers and across Duke's ten schools to foster collaborative and interdisciplinary research, teaching, and civic engagement. Recent strategic initiatives at Duke include expanding investments in community-engaged scholarship, interdisciplinary PhD education, and experiential, project-based learning at all levels; widening faculty access to complex project management; refining vehicles to promote research partnerships with nearby universities; revising the process of external review of academic units; and refreshing mechanisms to support and evaluate teaching excellence.

**Laura Howes** is Assistant Vice Provost for Interdisciplinary Studies and Bass Connections at Duke University. In this role she works collaboratively across the university to manage program design, implementation, assessment, and financing for interdisciplinary programs and Bass Connections. She also administers Duke's Interdisciplinary Strategy Council, a university-wide faculty body committed to strengthening interdisciplinary teaching and research.

## Open Spaces of University Campuses as Living Labs for Urban Sustainable Transformation: A Case Study

**Christoph Kueffer** is Professor of Urban Ecology and head of the research group Ecology and Planting Design at the Eastern Switzerland University of Applied Sciences; Lecturer at ETH Zurich; Affiliated Professor in Environ-

mental Humanities at Franklin University Switzerland; and President of the Network for Transdisciplinary Research of the Swiss Academies of Arts and Sciences. His research focuses on urban ecology, biodiversity conservation, novel ecosystems, and sustainability transformation.

**Irina Glander, MA** (Technical University of Munich), is a landscape architect and researcher with a decade of experience in public space design and construction. Since 2019 she has been a research assistant at the Eastern Switzerland University of Applied Sciences, where her research and teaching focus on experimental, artistic approaches and storytelling in landscape architecture.

**Sascha A. Ismail**, PhD in plant ecology and MSc in environmental sciences, is a plant ecologist and conservation biologist specializing in boundary work at the science-policy interface. He is a researcher and lecturer at the Eastern Switzerland University of Applied Sciences, as well as scientific staff at the Swiss Academies of Sciences.

**Mark Krieger**, Professor of Planting Design in Landscape Architecture at the Eastern Switzerland University of Applied Sciences, has decades of international experience as a planting designer and is the head of the Urban Green Space Living Lab at OST Campus Rapperswil.

**Gabi Lerch** is a landscape architect and researcher with a focus on garden design history. She is a research assistant and lecturer at the Eastern Switzerland University of Applied Sciences, where her research and teaching focus on experimental, artistic approaches and sustainability in landscape architecture. Gabi is the curator of the Urban Green Space Living Lab at OST Campus Rapperswil.

**Jasmin Joshi**, Professor of Landscape Ecology at the Eastern Switzerland University of Applied Sciences, is a plant ecologist specialized in biodiversity research and head of the Institute of Landscape and Open Space ILF at OST Rapperswil.

## University of California Los Angeles (UCLA) Sustainable LA Grand Challenge Undergraduate Research Scholars Program: Preparing the Next Generation of Transdisciplinary Leaders

**Rebecca Shipe** is the lead author of Chapter 5 and has been the instructor of the UCLA Sustainable LA Grand Challenge Undergraduate Research Scholars Program since 2016. She is an Adjunct Associate Professor at UCLA's Institute of the Environment and Sustainability—an interdisciplinary center for research and education that moves science to action on the front lines of environmental progress.

**Jane Lee** served as a Staff Research Associate with the UCLA Sustainable LA Grand Challenge Undergraduate Research Scholars Program. In her role as Teaching Assistant and Graduate Researcher for the program, she brought her experience with program planning, implementation, and evaluation to provide support within and beyond the classroom by assisting with scholarly support, program and alumni evaluation, and program diversity.

**Casandra Rauser** was the inaugural Executive Director of the UCLA Sustainable LA Grand Challenge and served in that role from 2014 to 2023. She led the development and execution of this transdisciplinary initiative focused on research, education, and real-world impact. In the nine years that she served in this role, she oversaw and contributed to the evolution of the Undergraduate Research Scholars Program. She brought to the program a broad knowledge of the complex urban sustainability issues challenging the region—and society broadly—and a deep understanding of the need to work across disciplines and sectors, inside and outside of the university, to co-develop implementable solutions to create a more equitable and livable world.

**Elizabeth Reid-Wainscoat** is a Campaigner for the Center for Biological Diversity's Urban Wildlands Program. This research was initiated during Elizabeth's time as the Senior Research and Policy Analyst at UCLA's Sustainable LA Grand Challenge where she primarily managed the development of the 2021 Ecosystem Health Report Card for Los Angeles County. Her experience assisting in student selection and group projects during the 2019–2020

academic year helped guide the development of and implementation of the assessment described in Chapter 5.

**Rachel Kennison** was the Developer and inaugural Instructor of the UCLA Sustainable LA Grand Challenge Undergraduate Research Scholars Program. She currently serves as Executive Director of the Center for Education Innovation and Learning in the Sciences (CEILS) and Associate Teaching Professor in the Department of Ecology and Evolutionary Biology at UCLA. She oversees the CEILS mission, which is to transform STEM classrooms and systems of higher education into inclusive, just, and equitable places for all students to learn.

**Marc Levis-Fitzgerald** is the inaugural Director for Assessment of Student and Instructor Experience at the UCLA Teaching and Learning Center, where he leads assessment and evaluation services designed to build data-informed transformation of pedagogical practices and improve the instructor and student experience. Previously, he led UCLA's Center for Educational Assessment for over twenty years, and he has extensive grant-funded curriculum and program assessment experience. For Chapter 5, he assisted with program assessment design, survey development, and manuscript revision.

**Erin M. Sparck** is a postdoctoral researcher at UCLA's Center for Educational Assessment. She works on the development and implementation of assessment strategies for various campus programs and researches improving the quality of instruction and student learning. She contributed to the assessment plan for the Undergraduate Research Scholars Program, the survey development, and manuscript revisions for Chapter 5.

## **Fickle Winds: Faculty Maintenance, Labor, and the True Cost of Transdisciplinary Initiatives**

**Stephanie Sadre-Orafai** is Associate Professor of Anthropology and Faculty Chair and Director of the Charles Phelps Taft Research Center at the University of Cincinnati. Throughout her career she has pursued multidisciplinary, interdisciplinary, and collaborative projects that blend research and creative practice, resulting in public-facing video, curatorial, and experimental design work that she also implements in the classroom. In 2011, with Jordan Tate, she established the cross-college Critical Visions Certificate program

that teaches students how to effectively combine critical theory and social analysis with art, media, and design practice and produces a biennial publication of student work from the program.

**Jordan Tate** has a BPhil in interdisciplinary studies from Miami University, an MFA from Indiana University, and was a Fulbright Fellow in 2008–2009. Tate’s current research practice is focused on inter/transdisciplinary collaborations that explore the physical/digital divide of art objects and collections and that aim to increase access to object-based knowledge as a public good.

## How Does Transdisciplinary Teaching Transform Those Who Teach It? Experiences from the University of Technology Sydney

**Dr. Alex Baumber** is the Director of Teaching and Learning for the Transdisciplinary (TD) School at the University of Technology Sydney (UTS). His research explores transdisciplinary practice around environmental and land use policy as well as ways to build transdisciplinary capabilities in students at undergraduate and postgraduate levels. His teaching in the Bachelor of Creative Intelligence and Innovation at UTS was recognized through an International Green Gown Award in 2022. His research into transdisciplinary learning and teaching has been published in *Higher Education Research & Development*, *Studies in Continuing Education*, and the *International Journal of Work-Integrated Learning*.

**Professor Bem Le Hunte** (Transdisciplinary [TD] School, University of Technology Sydney) is a multi-award-winning educator and founding Director of the Bachelor of Creative Intelligence and Innovation—a future-facing degree that teaches transdisciplinary creativity across twenty-six different disciplines at the University of Technology Sydney and now globally. She is an internationally acclaimed novelist and brings a narrative, whole-of-program approach to course design. She researches creativity and transformative learning while also developing what she describes as a “curriculum for being, not just knowing,” as she believes transdisciplinary learning should privilege the knower—not just the knowledges involved.

**Dr. Giedre Kligyte** is Senior Lecturer and the Transdisciplinary Electives Program Director at the Transdisciplinary (TD) School, University of Technology Sydney. Her research focuses on transforming university education to advance more sustainable and socially just futures. In particular, she explores how different perspectives and relationships across boundaries can be leveraged to create “third spaces”—environments where difference, experimentation, and co-creation are embraced to stimulate mutual learning, new ways of thinking, and creativity. Giedre is dedicated to designing learning experiences that prepare individuals for uncertain futures, with a particular interest in developing future-oriented capabilities such as systems and futures thinking, creativity, innovation, collaboration, and change making, as well as reflexive capacities.

**Susanne Pratt** is an award-winning educator, artist, and researcher working at the intersection of creativity, regenerative futures, sustainability transformations, and transdisciplinary learning. Her recent research explores participatory futuring and arts-based approaches to inspire environmental and social change in the present. Her creative work has been internationally exhibited in various forms, including site-specific installations, sound walks, performances, and participatory events. She is Senior Lecturer in the Transdisciplinary (TD) School, University of Technology Sydney, and works, lives, and creates on the land of the Gadigal people of the Eora Nation.

**Jacqueline Melvold** is Visiting Associate Professor of Practice and Compton Chair of Creative Intelligence and Innovation in the W.A. Franke Honors College at the University of Arizona. She is a multi-award-winning researcher and educator who seeks to create a space for mutual learning between educators, academics, and students to support transdisciplinary learning and professional practice for the empowerment of young people. Aimed at transforming the education sector, she supports educators in developing students who can thrive in a rapidly changing world and respond to complex societal problems—thus creating a more sustainable, just, and equitable future by reimagining preferable futures in education.

**Lucy Allen** is Lecturer in Creative Intelligence and Innovation in the Transdisciplinary (TD) School at the University of Technology Sydney. Practicing at the intersection of education, the arts, and innovation, Lucy is committed to realizing the transformative potential of universities and cultural institutions. Her research is based in education, where she examines progressive

teaching and learning practice; in particular, Lucy explores the role of collaboration, embodiment, and arts-based approaches in transdisciplinary higher education.

## Effective Transdisciplinary Teaching Teams: Professorial Perspectives on Collaboration and the Circular Model for Collegiate Co-Teaching

**Anne-Lise K. Velez, PhD** is Collegiate Associate Professor and the studio lead for the Honors College and affiliated faculty with the School of Public and International Affairs at Virginia Tech. She co-developed the initial Honors SuperStudio and is now scaling it with new faculty to create new student opportunities and studio availability both semesters. Within SuperStudio, she focuses in part on helping students understand environmental policy in relation to social change, and she also contributes to research methods classes. Her research broadly relates to management and decision-making at the intersection of the public and nonprofit sectors, especially around environmental and urban policy relating to community well-being and sustainability. She also studies pedagogy and publishes scholarship on teaching and learning.

**Stephanie N. Lewis, PhD** is Collegiate Associate Professor and the research methods instruction lead in the Honors College at Virginia Tech. Her research interests include understanding how undergraduates learn and use transdisciplinary skills like research practices and ethical reasoning. She co-developed the initial Honors SuperStudio concept and is part of the current instructional team responsible for planning and teaching the course.

**Ralph P. Hall** is Professor of Urban Affairs and Planning at Virginia Tech, the Associate Director of the Center for Future Work Places and Practices, the Head of Outreach and Engagement for the Center for European and Transatlantic Studies, and is an affiliated faculty member of the Honors College and the Myers-Lawson School of Construction. He supported the development of the initial Honors SuperStudio concept and is part of the instructional team responsible for planning and teaching the course.

**Zachary Underwood, PhD** currently serves as Dean of University College at North Carolina Central University. He helped in the planning process for the

SuperStudio and for three years co-taught a section of the Honors SuperStudio on the future of higher education with Daron Williams. His research interests include higher education, academic advising, student success, and video games.

**Daron Williams** is the Director of Instructional Design & Development for Technology-enhanced Learning & Online Strategies at Virginia Tech. In this role, he works with faculty and administration to plan, design, and build engaging technology-enhanced courses and programs. He and his team also consult with faculty about effective teaching with technology and facilitate faculty professional development around topics in the same realm. He teaches the “Future of Education” section of the transdisciplinary Honors SuperStudio course.