Towards a Content-Agnostic Praxis for Transdisciplinary Education

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Abstract
In this chapter, we describe a novel transdisciplinary undergraduate program that is focused on developing students’ praxis to address problems across disciplinary boundaries and provide a means to interrogate discipline-specific content, epistemologies, and research methodologies they might encounter across those spaces. We argue that undergraduate educators have the potential to inculcate students’ praxis to effect social innovation across disciplinary boundaries by facilitating engagement with three interrelated processes: habits of mind, ways of knowing, and the adoption of a transdisciplinary, content-agnostic skillset. We describe each set of processes, along with core transdisciplinary skills and ways of knowing, building towards a content-agnostic instructional design approach.

Introduction
Transdisciplinary Studies in Technology (TST) is a hybrid competency-based undergraduate program at Purdue University in which students develop innovative solutions to complex, real-world problems. The program was developed as part of a larger initiative within the Purdue Polytechnic Institute to create educational experiences aimed at preparing students for career success, even if those careers may not yet exist. Of central importance to the faculty designing the Transdisciplinary Studies in Technology Program was the equal standing and importance of humanistic and social scientific content and methodological approaches in technology education—where these perspectives were not in service of, but rather core to a more complex and holistic understanding of technological and social challenges. This humanistic-technological approach allows technologists to address the social dimensions of technological problems and to work at the intersections of technological and social innovation. Further, this paradigm allows students and future practitioners to gauge the limitations, rules, and biases of their own disciplinary areas. In TST, students declare two or more focus areas drawn from departments and programs across the University. They bring these focus areas into the TST design studio, where they are encouraged to explore relationships among disciplines and to create their own transdisciplinary identities.

As faculty that have contributed to this program, we view transdisciplinarity as both a process and a paradigm. As a process, students move through several stages, first becoming familiar with disciplinary content and methods, then transferring knowledge and skills and from one discipline to another, and finally selecting from and using multiple disciplinary perspectives (see Ashby, Exter, & Varner in this volume). As a paradigm, transdisciplinarity is a framework for acknowledging that all methodological approaches have limitations and for overcoming some of these limitations by working across, beyond, and through multiple disciplines in order to solve specific problems or accomplish certain goals. In the TST design studio, students learn to adopt this process and paradigm as they apply sometimes disparate knowledges and methodological approaches to confront ill-structured, real-world problems. While students attain much of their disciplinary background and related knowledge outside the TST program (i.e., through courses or other learning experiences across the university), the program is designed to support students’ exploration of these disciplines in the context of social and technological innovation. This environment encourages students to reflect on disciplinarity and to transfer and synthesize key concepts, common forms of evidence, methodologies, and approaches to inquiry from multiple disciplines.
In addition to the design studio, students develop a digital portfolio of their competencies in which they integrate their skills and knowledge into a holistic archive that represents their learning. The TST curriculum is content agnostic insofar as it foregrounds the attainment of broad-based and transferable 21st century skills such as problem solving, design thinking, systems thinking, entrepreneurship, quantitative reasoning, oral, written, and audiovisual communication, arts and culture engagement, critical thinking, leadership, and responding to conflict. Students’ portfolios show how these skills were demonstrated in the course of project-based learning. Disciplinary and interdisciplinary content, for example in the form of fictional narratives, critical theory, ethnographies, case studies, or documentary films, is driven by the types of problems students wish to address.

**Praxis**

Action and practice are commonly thought to be different from, and even opposed to, the abstract thinking that often characterizes theory. While Aristotle may be the originator of such a distinction, he also developed a concept of praxis or *creative doing* inspired by theory, which undermines or undoes this very distinction. In this chapter, we refer to praxis as the dialectical synthesis of theory and practice, not with the goal of putting theory *into* practice, but rather of creating knowledges and practices vis-à-vis theoretically informed action. Neither theory nor practice play a dominant or subservient role. Instead, through a dialectical synthesis of practice and theoretical knowledge, practice emerges from theory and theory emerges from practice. In *Pedagogy of the Oppressed*, Paulo Freire positions this development and activation of praxis in a pragmatist frame, describing this interaction as “reflection and action which truly transform reality” (p. 100). This understanding of praxis also resonates with reflection-on-action (c.f., Schön, 1983) in the design tradition, where the “reconstitution of *sophia* [facilitates] the integration of *thought* and *action* through design” (Nelson and Stolterman, 2012, p. 11, emphasis in the original). Reflection necessitates action and action necessitates further reflection, which necessitates even more action, and so on. The TST program seeks to develop students’ abilities—focusing on the notion of praxis—to effect social and technological innovation. In design studio, students are asked to engage with and even create theory, some of which may seem far afield from the practical or technical skills they wish to apply to certain problems. Ideally, they will also view the practical and technical skills they learn as tools for producing new methodologies, methods, and theories across the sometimes very different domains they wish to work in.

As it is for Freire, praxis is often taken to be a tool of revolution or subversion. Or in the words of Nelson and Stolterman (2012), praxis might be positioned as the mechanism for creating the *not-yet-existing*. We view praxis as a particularly apt metaphor for the curriculum we offer and the learning that takes place in our program, since our paradigm, at its core, is disruptive of the oftentimes rigid disciplinary, organizational, and hierarchical structures which constitute the traditional university and the relationships, for example among students and faculty, which exist there. We frequently encounter difficulties when we try to articulate the merging of technological with social scientific and humanistic inquiry and practice, and find ourselves, however unintentionally and as impacted by our disciplinary training, relying on language and concepts that seem to indicate that one serves the other. As a multidisciplinary team, we also confront frequent misunderstandings or miscommunications, in part because of our reliance on own disciplinary lenses and languages. A computer scientist and a sociologist may have very different views of high level concepts such as systems thinking, not to mention
practical and epistemological dissimilarities about what constitutes, for example, texts, reading, or empathy. Finally, we must also take into account the meaning our language and concepts may have for students who are not yet steeped in any disciplinary vocabulary, as well as parents and other stakeholders. Our own praxis, as researchers, curriculum designers, and instructors, has been to enact the same kind of creative doing—in the research and teaching spaces—that we ask our students to participate in, creative doing that will eventually allow us to find new concepts and new practices to bridge the epistemological and practical divides that seem to separate technology and the liberal arts.

Competency-based education more broadly, insofar as it focuses on students’ behaviors rather than the level of their performance or how they compare to their peers, also unsettles the traditional model of student learning and assessment. Within such a paradigm students may be freer to engage with faculty as mentors and collaborators rather than as authority figures or knowledge experts. The TST program, as discipline agnostic, encourages faculty to collaborate with and bring into the classroom knowledge experts from across the university, and to serve as guides in the learning process rather than experts. With this model of instruction and faculty mentorship as its basis, undergraduate education can facilitate students’ development of praxis to effect social and technological innovation across disciplinary boundaries by facilitating deep engagement with three interrelated processes: habits of mind, ways of knowing, and the adoption of a transdisciplinary, content-agnostic skillset.

**Habits of Mind**

We define habits of mind as attitudes or orientations towards learning, problems, and knowledge. Here, we describe three interrelated habits of mind that we have identified in the TST program that allow students to develop a self-reflexive relationship to their work, peers, and environments: critique, empathy, and reflection. By critique, we refer to a means of engaging with, communicating, and evaluating designed artifacts at any stage of their creation or use. A mindset of critique connotes that students are open-minded, flexible, and willing to engage in deep collaboration with peers, coworkers, faculty, and stakeholders (e.g., Gray, 2013). Critique is central to design education and to the TST studio experience, where students are consistently engaged in project work. Both formal and informal critique were integrated into the most recent first-year studio experience on a near-weekly basis. This first-year, first-semester experience was designed to highlight two major aspects of the design process: problem framing and iteration. During each learning module, students framed a predetermined problem, defined in advance by the instructional team and outlined in the syllabus, by working through and then applying interdisciplinary content. One day of each learning module was dedicated to informal, small-group peer critique, and one day was reserved for more formal, full-group faculty and peer critique. For formal critique, students were required to note and make decisions as to the relevance of each comment and to justify their decisions about whether or not to incorporate each comment. In critique, several transdisciplinary skills are foregrounded, including oral communication and active listening. Moreover, our second habit of mind, empathy, is activated in the process of active listening.

Empathy is a core “soft skill” (e.g., Walther, Miller, & Sochacka, 2017) that allows students to grapple with difference and examine and address systemic social inequities, for example those related to race, class, and gender. Empathy is also a cornerstone of design education and practice, insofar as it allows students and practitioners to understand and address the needs of stakeholders. It is the skill or ability to shift perspectives and acknowledge the inner
experiences of those who may not share the designer’s background (e.g. Thomas & McDonagh, 2006) with regard to age, race, gender, political or religious beliefs, and so on. In user-centered design, empathy increases the likelihood that practitioners will grasp the complexities of user’s lived experience and the contexts in which their lives are lived (e.g. Koskinen, Battarbee, & Mattelmäki, 2003). The transdisciplinary nature of our program allows students to engage in the kind of robust qualitative research necessary to foster this kind of deep empathy. By studying a variety of humanistic and social scientific methodologies for producing knowledge, students may move beyond cursory examinations of demographic data, for example, and instead develop robust theoretical or ethnographic studies to better understand the contours of their users’ lives. Our third habit of mind, reflection, is one of the primary pedagogical tools we have for fostering this kind of empathy.

Reflection allows students to engage with their stakeholders and their own learning experiences, develop a sense of their progress in attaining and mastering skills over time, engage in self-critique, and become more effective, lifelong learners (e.g., Tracey & Hutchinson, 2016). Reflection is built into our curriculum in several ways. First, as they create submissions documenting their attainment of competencies, students not only have to show evidence of the skill or ability; they also explain how the skill or ability was attained over the course of a project or learning experience. The metacognition required in this process ensures that students are able to transfer a skill or ability across a range of problems or projects. This reflection process often entails a description of the project or learning experience, an identification of which aspects of the project or process meet the specific outcomes outlined in the competency, and an evaluation of the strengths and weaknesses of the project or process. Narrating their own learning in this way allows students to develop a sense of their work as embedded and implicated in broader systems and to “tell the story” of their work to others.

Reflection has at times functioned as a hidden aspect of the curriculum, and it has been among the more difficult habits of mind for students to adopt in consistent and meaningful ways. For this reason, reflection has been added as a skill area into the most recent first-year ePortfolio class. While students have struggled to identify the importance of reflection to their practice, they have shown significant improvement in their reflective skills over the course of a semester versus previous cohorts where reflection remained implicit. Reflection is a means to an end, for example insofar as it is a tool to aid in or improve communication, but by focusing on reflection as an end in itself, rather than only a means to an end, students may be more likely to use reflection as a tool to improve their empathic abilities. By reflecting consistently and over time on their personal and professional experiences, goals, and values, students develop a sense of personal and social responsibility, the way these are reflected in, and how they can drive, their work (Nelson & Stolterman, 2012).

Ways of Knowing

We define ways of knowing as conceptual or theoretical frameworks for understanding the world, as well its socially- and culturally-situated challenges. Broadly speaking, students should develop a sense of the way knowledge is produced and disseminated across a variety of disciplinary and real-world domains. They should be able to identify some of the epistemological assumptions undergirding disciplinary formations and to analyze and interpret how these epistemological assumptions shape the kinds of questions that are asked, knowledges produced, and innovations implemented across these domains (Gray & Fernandez, 2018). For example, if a student is interested in solving an ill-structured or systemic problem, she or he will ask questions
about this problem that emerge from a variety of disciplinary and real world spaces, including, potentially, unusual or even ill-fitting spaces. By understanding that problems are context-specific, understood differently across different domains, and open to interpretation, students can develop rigorous research and practice agendas for solving problems while remaining intellectually flexible.

While content in the TST program is often contingent and replaceable, it is nonetheless an important tool for guiding students through these processes. Different topics and content are incorporated into the design studio each semester, allowing students to engage with and frame their problems in novel ways. In the most recent first-year experience, driven by problem framing and iteration, interdisciplinary content played a central role in allowing students to grapple with knowledge production. We provided students with a simple, albeit ill-structured, problem—that playground equipment is often non-innovative, outdated, and boring. The goal was for students to frame and reframe this problem in various ways throughout the course of the semester, based on sometimes well-suited and sometimes tangentially-related interdisciplinary content. A well-suited content area, for example, was embodiment. Students read material from the fields of phenomenology and gender studies, and were asked to take an embodied approach to playground equipment design. They viewed the playground from different embodied positions, threw tennis balls with their non-dominant hands, and practiced moving their bodies based on stereotypes they had about gender. A tangentially-related content area was criminal anthropology. In this learning module, students read nineteenth century criminology in order to understand the once-dominant epistemological view that personality and behavior were dictated exclusively by biology. The semester’s content was chosen, in other words, to showcase a diversity of epistemological and methodological frameworks that students could use to frame ill-structured problems.

Students in the program choose their own disciplinary focus areas, and they bring related content and methodology into the design studio. A central feature of the instructional model is collaboration among faculty and students. In this way, faculty should allow students’ emerging disciplinary identities to shape future iterations of the learning experience. For example, when students are interested in psychology or education, faculty may choose to incorporate articles or studies from these disciplines in order to work through them with the entire class. This gives individual students, and the class as a whole, the opportunity to grapple with questions of epistemology and methodology that may not arise in the undergraduate curriculum from which it is drawn. By working through material with students as non-experts, faculty can guide students through the process of transferring and synthesizing sometimes disparate ideas and methods in the context of project work.

**Transdisciplinary, Content-Agnostic Skillset**

Our program includes five content-agnostic competency areas: create and innovate; engage in culture, values, and the arts; inquire and analyze; communicate; and interact with others. For brevity’s sake, we will discuss only the first three. Each of these areas comprises a subset of related skills and abilities.

By attaining competence in creativity and innovation, students will achieve proficiency in design thinking, problem solving, entrepreneurship, and systems thinking. Engagement with design processes is a central methodology for student creativity and innovation. Design is transdisciplinary or discipline agnostic insofar as it is a body of knowledge and practices whose aim is to address ill-structured problems that are situated in complex and often interrelated
systems. Performance indicators for design thinking include identifying and framing problems, identifying and testing multiple design solutions, conducting user research and testing, and prototyping. While design thinking is one method for solving problems, students also develop competence in other problem solving methodologies in the context of the problem solving competency. In these two areas, students observe, empathize, conceive, plan, execute, test, and reflect in order to identify problems, create solutions, or adopt new practices. Systems thinking encourages students to describe, analyze, and envision a system as a dynamic entity of interacting and interdependent elements acting as a whole. As systems thinkers, students’ creativity and innovation is strengthened by their ability to see how problems are situated in complex social, cultural, legal, political, and other systems. Similarly, entrepreneurship fosters creativity and innovation insofar as it encourages students to understand potential needs, markets, and stakeholders and to develop and act on opportunities that will have value to those markets and stakeholders.

In the second area, engage in culture, values, and the arts, students make decisions and accept responsibility in the context of culture, values, and worldviews, and they act with an understanding of the socio-economic, ecological, and cultural independence of contemporary, global life. In culture engagement, students identify what constitutes culture and cultural groups, analyze how actions, perspectives, and values emerge from culture, and evaluate their own cultural perspectives and biases. In arts engagement, they identify and analyze how art- and made objects, as well as aesthetic values, emerge from culture and how art makes statements or tells stories about culture. In ethical engagement, students identify the ethical stakes of their problems or projects and analyze the ethical implications of different courses of action. Finally, in inquire and analyze, students learn to integrate, synthesize, and produce new knowledges and make informed and critical judgments about the world around them. They learn to think critically, discriminating between relevant and irrelevant information, analyze and synthesize information or knowledge about a topic, and question their own and others’ assumptions. In this area, students also demonstrate competence in quantitative reasoning, both analyzing and creating information represented quantitatively and drawing conclusions from this data. By embracing the kind of complexity foregrounded in these areas, students can draw on multiple epistemological and methodological frameworks to understand and solve problems.

**Conclusion**

While the curricular areas we have discussed are conceptually discrete, they are also interrelated, and students are better able to grasp their holistic nature armed with the habits of mind and ways of knowing outlined above. At the same time, this learning process is non-linear. Habits of mind do not come “before” or “after” ways of knowing or the attainment of transdisciplinary knowledge, skills, and abilities. Instead, these three processes are interrelated and often overlapping in the curriculum; some of the habits of mind and ways of knowing we have identified are also embedded in our transdisciplinary skillset, and some habits of mind, such as reflection, are required to demonstrate competence in the content-agnostic skillset.

The program offers two courses, the design studio and portfolio class. As we continue to develop this learning experience, ideally these courses should be well-integrated, with faculty from each collaborating to show students how they may be using a variety of content-agnostic skills, such as culture engagement, systems thinking, quantitative reasoning, or communication, even where these skills are not the explicit topic of instruction. Such integration and collaboration can make the curriculum more transparent to students and encourage them to
participate more actively in each aspect of the learning process. Ideally, the kind of learning that will happen in the TST program will blend design and technical education with humanistic and social scientific education. At the same time, it will, again ideally, merge theory with practice, inviting students to develop their own praxis for implementing the kinds of social and technological changes they wish to effect in the world.

References
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