Meta-Activity Theory as a Conceptual Tool for Supporting Transdisciplinary Curricular Experimentation in Undergraduate Learning Contexts

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When it comes to carrying out external evaluations of academic plans in higher education, Lisa R. Lattuca and Joan S. Stark's text, *Shaping the College Curriculum: Academic Plans in Context,* has provided a critical resource (Lattuca and Stark, 2011). The text lays out a framework for analyzing the social aspects of curricular plans, which often involves examining how the intended curricular design of an academic program compares to the actual lived experiences of students and faculty who are involved in the curriculum. By drawing on Lattuca and Stark's framework, external evaluators can employ qualitative research methods to investigate how social assumptions or competing values and interests shape and are shaped by the learning activities that make up the curriculum. These insights in turn provide external evaluators with information and examples that they can use to develop reflexive activities for guiding faculty and staff in re-examining and making adjustments to certain educational activities (Lattuca and Stark, 2011).

These contextual insights are particularly important now, considering the increasingly porous relationships that academia has been actively cultivating in recent years with external stakeholders, including business and industry, the social landscape of external evaluation in higher education is quickly shifting (Clark-Stallkamp and Garmise, 2020). This includes the emergence of "transdisciplinary" academic plans that are being developed at universities and colleges throughout the U.S. that partner with industry and aim to respond to public sector demands for graduates who are trained to work on mixed-disciplinary research and development teams. Prominent examples include Arizona State University's EdPlus (Arizona State university, 2018), Bennington College's "Field Work Term," Georgia Tech's "Creating the Next" (Georgia Tech, 2021), and Purdue's "Hands On Education - Real World Success" Initiatives (Purdue, 2020).

In this paper we draw on ethnographic research that was conducted as part of an external evaluation involving a newly launched transdisciplinary, undergraduate curriculum at a large research university in the U.S. The research conducted for this evaluation led to several insights on how students in this program are being socialized to carry out cross-disciplinary, team-centered learning projects. As part of the non-academic partnerships, this includes participating in learning activities that train students to employ methodological tools and schematics for conducting research on complex problems that are borrowed from business and industry. Such practices are viewed by the faculty and administrators of this program as curricular pathways for training the next generation of transdisciplinary thinkers and innovators, which, in addition to large funding gifts, is one of the reasons why this program is actively involving business and industry experts in the development of their curricular activities. Yet, while faculty and administrators argue that the new curriculum has immense value for advancing undergraduate education, they simultaneously worry that such collaborations will circumspect the transdisciplinary goals of their curriculum. As one academic stakeholder reflected, the degree program has the potential to transform how the university thinks about individual learning plans for undergraduates that exist outside of traditional disciplinary frameworks, but it also "shouldn't become a pipeline for business and industry."

Alongside this tension—and partly in response to it—the authors of this paper were hired to conduct an external evaluation of the program's newly launched undergraduate design studio

course.[1] This involved conducting nine months of ethnographic research involving interviews with faculty and administrators involved in the program's initial design, observations of classroom activities, and follow up interviews and focus groups with the first cohort of students. In the process we gathered insights that provided feedback to faculty and staff that could help further develop the curricular aims of the program, while also theorizing through our ethnographic project how external evaluations can contribute to the development of transdisciplinary learning communities in higher education. Our external evaluation activity is presented here as a case study that considers how activity theory - or a *meta-activity theory* - can be used to inform the development of transdisciplinary undergraduate curricula. This ethnographic approach extends Yrjö Engeström's work on activity theory to both the fields of transdisciplinary education and external evaluation in higher education (1999). But it also requires recognizing that the activities carried out by external evaluators constitute an activity system in and of itself. This system is separate, but also connected to the activity systems used by faculty and staff to teach courses and administer degree programs.

Through this framework this paper describes how external evaluators can engage in co-producing transdisciplinary academic plans with other stakeholders. As will further be illustrated in the following sections, this perspective also makes it possible to critique administrative approaches in higher education that privilege classroom activities over other forms of educational work that are necessary for developing transdisciplinary curriculums, such as the work of external evaluators. By focusing on external evaluation as an integral component of an educational system, this paper seeks to highlight the value of this seemingly "peripheral work" (Lederman, 2019). This in turn raises critical questions about how power dynamics and other asymmetric relationships can be exposed early in the development of an academic plan. Such exposure is important if the principles of transdisciplinary curriculums are to be fully realized in ways that allow for both faculty and student agency, as well as the cultivation of new collaborative organizing practices that bridge disciplinary divides and contribute to the needs of external communities, while not being subject to co-optation.

In the following sections we present our case study, beginning by situating our methodology in relation to wider transdisciplinary trends in higher education and the stakes that educators face when they implement these trends. Next, three examples are presented that examine the socializing implications of learning activities used in a first-year studio course that is designed to introduce students to key conceptual tools and methodologies that they will explore in greater detail throughout their four years of instruction. These examples illustrate how assumptions enter into the teaching and learning process and how it is valuable to revisit curricular aims and practices by comparing the goals and aims of the academic plan to the observed experiences of students. Finally, we introduce the concept of *meta-activity* as both a means for enriching the educational work and scholarship on transdisciplinary learning, as well as a conceptual tool for theorizing power dynamics in transdisciplinary curricular development.

[1] When we began working on this project both authors were Virginia Tech employees who worked in separate entities of the university than the program we were asked to evaluate. This includes McNair's role as Director for the Center for Educational Networks and Impacts, which provided evaluations of curricular and outreach programs for the university. Nicewonger was part of a separate administrative unit focusing on the development of a campus-wide transdisciplinary learning and research initiative. Additionally, both evaluators were familiar and had previous experience working with some of the staff in the program they were working for.

Methodology: Analyzing "Decision Points" using three examples of Design Socialization
This research was embedded in an external evaluation study utilizing Lattuca and Stark's model of focusing on decision points that together make up an academic plan. Ideally, decision points intentionally address curricular elements and take into account factors in the wider sociocultural context (pp. 5-6). Our objective was to identify decision points and understand how they play out in socially specific and interrelated ways across an academic plan. To frame this investigation, we drew from socio-cultural theory to examine the influence of socialization processes in a transdisciplinary undergraduate honors program. Beyond course assessment, this type of analysis of the socio-cultural influences of socializing practices is critical for ensuring that continuous reflection and adjustment is iteratively built into the implementation of newly initiated curricula (Lattuca and Stark, 2011: 229). In this section of the paper, we further explain these conceptual frames and their role in our methodology.

Background, setting, and participants
Over a nine-month period the authors conducted ethnographic data collection that included interviewing over 50 faculty, staff, external stakeholders, and students; observing and participating in program activities; and contributing to the pilot of the academic plan with the inaugural first two courses in the program's four-year curriculum. The academic plan was designed by faculty and staff from diverse academic backgrounds who identified key learning goals and objectives, and the plan was used to secure substantial funding from an industry sponsor. The subsequent academic program planned to enroll approximately 40 high-performing students each year. In the first year of this customized Honors program, students were recruited from the incoming pool of university applicants, and the first class included students majoring in engineering and other STEM majors, as well as non-STEM fields. The first cohort was made up of traditional-age first-year students, in that they had graduated high school a few months prior to beginning college and consisted of a 60/40 male/female ratio. Additionally, all students in this program were provided full scholarships for four years, which covered room and tuition fees. They were also given funds for supporting independent learning activities, like summer internships or research projects.

Led by a tenured full professor with interdisciplinary degrees and administrative appointments, the all-male core instructional faculty were hired in renewable non-tenure track positions after the academic plan was completed, and all four were new to the university. These core faculty came with interdisciplinary backgrounds and expertise in computer science, data analytics, industrial design, and computer engineering. In addition to university instructors, several visiting instructors from business and industry with backgrounds in engineering were also involved in teaching courses and/or participating in student critiques, workshops, and mentoring programs. These visiting instructors worked in industries that had gifted the university record-breaking amounts of funding to develop this academic program. One of the visiting engineering faculty members was assigned to be on campus full time and co-taught and mentored students. A smaller group of mentors and advisors from nonprofit organizations also participated in curricular activities, but the nonprofit partners were not involved in course instruction, and their involvement in ongoing curricular design and programming was mostly limited to mentoring activities that focused on exposing students to nonprofit models. Finally, the instructional staff was supplemented by buy-outs of faculty with expertise in communication, humanities, engineering, ethics, and data analytics.

Integral to the curricular organization of this academic plan were collaborative, cross-disciplinary projects where students were introduced to "real world problems" that they worked on in small groups or teams. Outside of this studio course, students were also pursuing individual majors from different disciplines, with over a third in engineering. So, while the students in this program took courses in a specific major, their academic plan also required them to participate in a series of transdisciplinary studio courses where they developed methods for working on transdisciplinary teams. This undergraduate learning structure was unique at the time this study was carried out for this campus community because students in the program were pursuing a double major, including a degree in their major of choice and another that reflected their transdisciplinary training. As one administrator explained, "it's an experimental space to try and understand how we can create more flexible personalized curriculum for students. Which is really hard at a large decentralized campus."

This brings us to a final yet important contextual factor that concerns how transdisciplinary learning was defined by faculty and staff involved in the planning and implementation of this academic plan. The primary way in which this definition was communicated was through a series of key curricular objectives, which we summarize below:

- The *core principles* of the academic plan were to prepare students to:
    - work in collaborative, interdisciplinary teams on complex problems;
    - develop technological innovations that account for and have a social impact;
    - earn an integrated degree that combines requirements from whatever degree program they are majoring in and specialized transdisciplinary curriculum under analysis here.
- The curriculum was organized around a series of transdisciplinary studio courses spread across each semester of the four-year degree program. This included studios that involved students in *team-based problem-solving exercises* that drew on design and complex theories and methods. It also involved individualized studio courses and activities, internships, and mentoring activities with both program faculty and external stakeholders.
- The *problem-based learning* used in the studio courses focused on technological issues that have direct relevance to either the public sector or business and industry. In the first several years of the program, students were expected to work on projects from both contexts, but in later years could specialize in a single area.

By defining transdisciplinary learning through these key objectives, faculty and staff in this program were able to translate key pedagogical principles and transdisciplinary commitments into a teachable academic plan. Their definition also illustrated how the curriculum was organized around joint activity and learning that reflected localized interpretations of how transdisciplinary knowledge emerges through culturally and historically informed activities.

Theoretical Framework: Design socialization and joint activities

The original curriculum designers of the transdisciplinary program aligned their vision with theorists like Lev Vygotsky and John Dewey, who emphasized the interactional relationships that form through social engagement in both informal and formal learning environments (Dewey, 1938). Building on this interactional lens, Måkitalo, Nicewonger, and Elam (2019) have argued that researchers working in the learning sciences need to pay critical attention to how thinking is shaped by the design of learning tools and related semiotic artifacts (cf. Säljö, 2019), an

approach premised on the idea that cognition happens through social interactions with the material-social world. "It is simply no longer possible to analyze how people understand, reason or argue without taking into account their use of artifacts" (Lantz-Andersson et al. 2019, p. 14).

To scope our ethnographic data collection, we focused on examples of *joint activity*, defined as occurring when students interact with both human and non-human actors and advanced practitioners and/or their peers, as well as socio-material artifacts that are designed to mediate knowledge producing processes (Hutchins, 1995; Vygotsky, 1978). Through these interactions, students learn to employ shared terminology for conceptualizing design ideas, as well as the meanings associated with terminology (Lave and Wenger, 1991). They also learn to use design tools and socio-material artifacts to conduct design investigations and prototyping experiments. Additionally, these activities can become opportunities for both faculty and external stakeholders to share with students - stories and idiomatic references that convey how a particular design method is related to the professional social worlds that students aspire to someday enter (Wenger 1998; Lave, 2011; Nicewonger, 2018). These exchanges in turn deepen students' understanding of design processes and socialize them into particular ways of producing and evaluating design knowledge. As socio-cultural learning scholars, Gutierrez et al. (1999) explain:

> Collaboration here is understood as a process in which participants acquire knowledge through co-participating, co-cognizing, and co-problem-solving within linguistically, culturally, and academically heterogeneous groups throughout the course of task completion. The goal is learning, and joint activity facilitates or mediates learning for the participants (p. 87).

Consequently, by attending to how joint activity shapes student learning, ethnographers can generate descriptive models of multi-scaled learning processes. This requires comparing how classroom learning experiences are related to the curricular goals of the academic plan in which a particular course or learning activity belongs, and vice versa. But such analyses must also consider the influence of external factors, since institutional learning processes are sites where multiple socio-political networks and competing interests converge.

In the context of this paper, this included investigating how assumptions and claims about transdisciplinary design find their way into learning activities, whether intentionally or unintentionally. It also meant examining decision points that impacted how learning activities either transformed or reproduced social hierarchies and how forms of differentiation could obscure alternative learning approaches and student agency.

Results

Building on this analytical framework, we now turn to three socializing examples that highlight shared linguistic practices, socio-material artifacts, and critique processes, followed by a discussion of how socializing practices are experienced in this program. The analysis considers three interlinking questions about the socio-cultural implications of these practices on the academic plan as a whole: 1) What implications do these socializing practices have on students' aspirations for becoming transdisciplinary thinkers and practitioners? 2) How do these examples function as ways for faculty to both reflect on and revise the curriculum? 3) How does the role of external evaluation in this process illuminate insights for the planning and implementation of transdisciplinary curricula?

Example 1 – Socialization and Shared Linguistic Practices

In this first example we will focus on three linguistic tropes embedded in the program: the concept of "systems thinking" and the analogy of "the helicopter approach" to systems thinking, along with the concept of "real-world problems." These terms were invoked by faculty in multiple contexts to frame the program's studio approach to design education as distinctive from other academic experiences and to guide students into transdisciplinary ways of approaching problem spaces. Keating and Jarvenpaa (2016) described the use of frames as a way of making common ground visible: "There are recognizable ways people are behaving and talking and using space and objects that *frame* what's going on as an activity that's different from surrounding activities" (p. 105). The transdisciplinary collaboration program was designed to be a place of common ground in which students would learn to problem-solve in ways that were more authentic than other programs. This framing of language occurred as part of three different design projects, two supplemental assignments, and in critiques of student work. These linguistic practices were actively used by students and faculty as they communicated to one another about varying aspects of their design processes. These examples were also employed, albeit to a lesser degree, by outside visitors and external faculty who were invited from time to time to provide students with feedback on their projects.

An example of how the concept of systems thinking was communicated to students includes the phrase's use in formal lectures. In one such lecture, two faculty members outlined how the systems approach should be used by students to carry out research and organize their findings. In delineating these practices the faculty members defined the concept, saying:

Instructor A: We don't want you to jump from problem set to a solution. We want you to employ a systems thinking approach. It's about relations.

Instructor B: The systems approach helps balance the different considerations. It helps identify relationships and make connections. It's about scope and identifying strengths.

Instructor A: It's your Petri dish!

The following excerpt by a student illustrates how faculty enriched students' understanding of this concept through informal conversations and lectures where they expanded on why the concept was important to training and how it will shape their work on various complex problems.

> Overall, I thought the other lectures were helpful too, just when they talk about systems thinking and design thinking and all that stuff, because those are things that we've never done before, so I think it's definitely helpful to have them reinforced.

In fact, similar student-teacher interactions were observed throughout the course, and the concept became a shared linguistic resource for communicating about different aspects of the design process. This point was reiterated in interviews with several students at the end of the semester, citing the value of systems thinking to their personal development as transdisciplinary professionals.

Another way in which students were linguistically socialized was through the analogy of the "helicopter" approach to indicate the need to view a problem space from a high-level viewpoint and be able to precisely land on an intentionally scoped area of focus. Faculty used this analogy to help students *imagine* how to think about scale, and students quickly picked up the terminology. For instance, the project prompts for each of the design projects focused heavily on complex social issues (e.g., sustainability, prison reform, educational attainment in minority communities). Because of this, scaling strategies became a much-discussed topic as students attempted to frame their transdisciplinary design projects. This was also in part because scale was an idea that faculty felt would help students think more critically about the systems approach theory. For these reasons, the "helicopter" idea was one of "the most important things" students said they learned during the semester. As one student argued, this idea provided he and his teammates with a way to talk about scale. It also helped them learn how to scale design problems so they "weren't too big." Other students explained that the helicopter analogy taught them how to avoid prematurely focusing on solutions. In other words, students argued that the helicopter approach taught them to "look at the problem from above and then you can get closer to it." Thus, the students picked up the helicopter analogy and associated it with how they approached problem-solving.

Another concept that instructors used to teach students how to develop transdisciplinary design projects was the notion of "real-world" problems. Unlike the systems approach concept or the helicopter analogy, the notion of real-world problems was used by faculty to authenticate the curricular philosophy and goals of course assignments. Faculty would explicitly make comparisons between their program's "transdisciplinary" curriculum and other disciplinary-centric curricula. For instance, faculty used the concept of "real-world" problems to situate the curriculum with trends of transdisciplinarity that had informed the development of the academic plan. These theories largely (but not exclusively) drew on claims about "the future of work" – a prevalent theme in business and in funding entities like the National Science Foundation. Itself a transdisciplinary initiative, conceptualizations of the future of work included the idea that social innovation was rapidly transforming the type of skills needed in the workforce. As a result, students were continually being told by faculty and industry visitors that once they graduated, they would enter a workforce made up of collaborative teams of diverse specialists who were tasked with addressing complex problems.

Interviewer: What were some of the things you learned from the studio?

Student: They're trying to prepare us to, I guess, be in the real world and that's something I'm very thankful for because when I see my peers at other schools, I feel like I'm getting such a unique experience.

However, despite the theoretical emphasis on social innovations, the majority of the project examples and visitors who mentored students on these projects were from industry. At one point in the semester, one nonprofit mentor worked with two student design teams, but the time and resources allotted to the nonprofit mentor was less than that allotted to the other mentors. Moreover, there was very little effort to bring in nonprofit experts from the university to help shore up this imbalance. As a result, many of the social interactions in which notions of real-world problems were being discussed drew on for-profit business and industry examples. Noting the impact that this imbalance had on student learning, one student commented:

> The issue with my mentor specifically is [that] all the problems I've worked on have been social problems. And there's not really one mentor who's really good at social problems. I feel like the overall program is very technology based.

In a similar vein another student argued:

> If you had to choose one project that encapsulated [the program], I feel like it would not necessarily be the nonprofit groups. And the reason why I feel like this [is because] a lot of times the social problems are so complex and multilayered … [that in a] five-week period to even come up with anything I think is so unrealistic because working on something like prison reform is a policy-driven issue.

Given that one of the central goals of the program's academic plan was to generate student learning experiences that expose students equally to both nonprofit and industry sectors, this imbalance in nonprofit mentorship was viewed as a weakness. Similarly, the academic plan made a clear commitment to having a diverse set of experts to mentor students, but a lack of female mentors was an obvious gap.[2] Unfortunately, these imbalances were not discussed in relation to "real-world" circumstances.

Example 2 – Socialization and Socio-Material, Semiotic Artifacts

In this second example we examine a course tool referred to by students and faculty as the Quadrants and fitting the element of "artifact" in Engeström's activity theory model (1999). The term "systems approach" was actively used by faculty in talking with students about how to apply the Quadrants to their collaborative projects, and students quickly began using the same terminology to talk about how they should use the Quadrant or to further unpack how to go about developing their projects. The Quadrants also played a notable role as a social mechanism in the day-to-day learning experiences of students in the studio course. As a linguistic tool and artifact, it was a way of socializing students to *imagine* how to engage complex problems by framing design activity, which in turn was informed by certain pedagogical philosophies and theories.

The Quadrants tool also played a role in acculturating the core faculty, even being used as shared tool for their orientation into the program's teaching philosophy. It was not designed by studio faculty but by a curricular design committee who developed the academic plan prior to the program being launched. Yet the incoming faculty would be responsible for implementing the curriculum designers' vision. When the students arrived on campus and were enrolled in their first studio course in the program, the Quadrants tool was used to introduce students to framing transdisciplinary design problems. In the process of its day-to-day use in the classroom, its meaning grew and became more nuanced as it was applied in design projects. The Quadrants also became a capacious resource for communicating the values associated with framing transdisciplinary design problems in the studio course and became a touchstone for assessment of student work.

[2] Changes were made the following year that directly addressed these issues. But the point here is to illustrate how the original studio course was organized and implications that our external evaluation highlighted in identifying decision points that could be reflected on and amended to better meet the transdisciplinary goals of the program.

Reflecting on the impact that the artifact had on their learning experience in the studio, one student commented during a focus group at the end of the semester:

> Yeah, I do like the Quadrants. It's new and it takes some getting used to. It wasn't immediately obvious [to me] how to find its value and importance. I think the thing that made the most sense to me was having it explained to me by the mentors. When we got the feedback from our projects, the thing I remember was after we gave our presentation, Dr. A explained that our biggest gap or missing piece was how we were using the Quadrants.

Another student elaborated on this point further by connecting the Quadrants to other tools:

Student: The Four Quadrants I thought were … a great lens to look at everything, whether it's a project or a perspective or a problem. I think the introduction of the Four Quadrants was definitely something I saw initially going into working on [the project], but I didn't know what it meant. And now it's just, I think it's a really great lens to look at everything with.

Interviewer: So, you understood how to use if after using it several times?

Student: Exactly. Yeah. Getting a balanced feeling of which ones I need to focus on personally. I need to focus on viability more. Sustainability is obviously like my major really, so I assume that's my strength, but I think that desirability to do a good job is as well.

This student's internalization of the Quandrants tool as a general evaluation tool shows how artifacts can influence how students learn to think in specific ways that reflect the goals and philosophy of curriculum designers, instructors, and administrators.

Example 3 – Socialization and Critique

This final example shows how a more explicitly evaluative joint activity impacted the program's goal of building the program as a lasting community of practice. The first semester of studio work was segmented by "chapters" of activity – time-bound containers in which student teams worked with a business mentor to map a problem space and ideate a process or product as a potential solution; these ideations were then presented for critique by peers, faculty, and business representatives. Some of the critiques were structured using a digital tool that was designed to help instructors use critique as a teaching tool that could scale up to large classrooms in online and in-person formats. The developer, who emphasized research supporting the educational value of engaging in the critique process, was invited for an on-campus visit to customize the critique software for use with the quadrant tool. Students would give and receive critique to learn not only about the strengths and weaknesses of their products but also about the practice of critique itself as a skill valuable for the workplace.

This framing of the curriculum as a series of studio projects supported by formative critique was discussed by the core faculty as a way to build the program as an authentic learning environment that resembled Lave and Wenger's concept of a Community of Practice (CoP) (1991). A transdisciplinary CoP model could provide not only room for gaining deep disciplinary

knowledge and teaming skills, but also impact students' professional identities as learners, researchers, and practitioners in ways that would be both cognitively flexible and aligned with industry practices. In particular, the core faculty theorized that the students, instructors, and external partners as a group would engage in a *joint enterprise* that generates *mutual engagement* and *legitimate peripheral participation,* leading to and facilitated by a *shared repertoire* (1998). The two previous examples of socialization show initial elements of a shared repertoire, and the critiques were seen as a way to practice legitimate peripheral participation. The *joint enterprise* of the program, in Wenger's model referring to the larger set of goals, focused on using models, tools, and strategies to address problem spaces presented by faculty and business mentors.

However, an increasingly evident element of the joint enterprise in the first studio was that of preparing impressive performances for visits by the industry partners and sponsors. These visits were often announced with little lead time, and preparation took over studio activity leading up to the visit. While the organizing properties of the Quadrants tool were strongly reinforced in this preparation, the practices promoted through the formative critique tool were dropped. In a critique close to the end of the last "chapter" of the first semester of the program, each group presented their work to a room packed with their fellow students, their studio and module instructors, faculty from other departments and from the original curriculum design team, the industry partners, and the primary program sponsor. It was difficult for everyone to hear and see, and this resulted in a somewhat exclusive critique discourse. While the student groups all dutifully presented their projects through the lens of the Quadrants, the critique portion consisted of a few faculty members asking questions, with industry members impressed by the obvious intelligence and diligence of the students but also confused by the criteria for success. In future critiques the industry partners would follow this example, resulting in a summative critique process where the questions were not aligned with the instruction, and the session was primarily a showcase.

While typical of final presentations in many courses, and perhaps even authentic to some workplace contexts, the learning outcomes for students shifted to on-demand performances that privileged the (uninformed) power of the guests. In contrast, if the process authentic to the studio's evolving community of practice had been preserved, the guests would have witnessed a process more representative of how the shape of the curriculum was evolving. So, the critique tool, conceived as a way to build a community of practice, was supported by the overlay of the Quadrants tool (which was intentionally incorporated), but disrupted by recourse to the standing authority of instructors and industry representatives. This process initially appeared to be accidental but would quickly be seen by everyone, including the students, as determined by hierarchies and dependencies on external funding. From an evaluation point of view, the learning outcomes and how they were measured were not clearly defined or linked to an identifiable set of grading criteria. This flaw was consequential, since the students – many of whom were recruited to fill out a "diverse and inclusive" cohort maintained their funding through meeting required grade point averages.

Discussion: External Evaluation, Meta-Activity Theory, and Power

In this discussion we return to our research question that explores the ways in which external evaluation can examine socializing practices to better understand the implications they have on 1) students' aspirations for becoming transdisciplinary thinkers and practitioners, 2) faculty

members' efforts to shape, examine, and revise the curriculum, and 3) opportunities for planning and implementing transdisciplinary curricula. Employing a socio-cultural framework, this paper has highlighted how attention to joint activity can become important for externally evaluating programs that are designed to work across disciplinary lines as part of a wider effort to leverage university resources for addressing complex problems. Research carried out as part of an external evaluation of an academic plan not only opens spaces for examining how curricular practices operate, but it also allows evaluators a position from which to ethnographically track how the curricular goals of an academic plan become skewed in ways that compromise its transdisciplinary aspirations. In the examples described above, students were being taught to embody a certain understanding of the history and value of engaging in transdisciplinary collaboration. This necessitated the use of shared language practices and socio-material artifacts, like shared terminology, the Quadrants tool, and the critique process, that were employed by the faculty and staff to socialize students into certain ways of collaborating, framing research questions, and engaging in activities that were recognizable to their peers and instructors as being transdisciplinary in scope and nature. In the process students developed a positionality that helped them distinguish their educational experiences in this transdisciplinary program from their discipline-led studies.

However, the examples also show that the design of the academic plan drew heavily on learning tools, schematics, and collaborative activities borrowed from business and industry partners. For instance, in student focus groups several students questioned the applicability of the course's primary methodology when working on nonprofit problem spaces. "I feel like the overall program is very technology-based… [and] if you had to choose one project that encapsulated perfectly [this program], I feel like it would not necessarily be the nonprofit groups." Moreover, as this student explained, many of the students were interested in working on problems facing the nonprofit sector rather than business and industry yet the "tools that we're given" and the time limitations just don't work well for those kinds of problems. Similarly, questions arose about the applicability of a singular tool and the over-reliance on schematics and methods imported from business and industry, especially when nonprofit mentors were not included.

Furthermore, interactions between students and instructors, for example, used stories and examples taken from industry partners' business contexts. In addition, supplementary tools that were presented as methods but were adopted from corporations were used to carry out research in the program's transdisciplinary problem spaces. Moreover, when describing the terminology, the Quadrants tool, and the critique practices, students also tended to talk about them as if these practices were the only methods available to them. The fact that the course was only 15 weeks long and served as the introductory course to the academic program limited its breadth. Nevertheless, the design of any learning artifact, we argue, is shaped by politics because the creators of these artifacts are cultural beings who bring their worldviews into their design and use (Winner, 2009). Attending to the socializing effects of tools, their normalization, and their relationship to both the curricular objectives of an academic program and wider sociopolitical interests (e.g., external funding schemes) can generate insights into the politics of learning artifacts and the impact.

That said, the point here is not to critique or promote the idea that we – the authors and external evaluators of this program – advocate that these practices should be changed or altered. Since the beginning, the faculty charged with implementing another team's curricular design vision have

been enacting a process of continuous improvement. Our role was to present observations of patterns, cultural logics, and value orientations and to show how they compare to the goals of the academic plan so that faculty and staff involved in this program could reflect and decide whether to make significant curricular changes or to continuously make adjustments as needed.

As Dewey observed, practices in school influence the ways that students value knowledge and learning (1997). In a CoP, conceptually, elements are continually negotiated among community members whereas in academic teaching and learning settings instructors attempt to set standards that represent "knowledge" that can be assessed or, at least in this case, skills that will be useful for the immediate goal of earning good grades and the goal of performing in the workforce (Lave and Wenger, 1991). The socializing that happens in most higher education settings both continues the authority model of standards and begins the transition into workplaces that may or may not operate as negotiable sites. One of the lead faculty characterized the class as "studio work, not instruction" and described the Quadrants as a tool that could be used "as a lens to figure out complex problems and find connections at different levels." Since the faculty were implementing for the first time a model just recently developed by others, tools like the Quadrants and the critique process would predictably be "flawed" but could be "adjusted as needed." As they brought the program to life, the faculty team thought of the studio model with critique to be "changing the notion of instruction altogether" where "deep interactions like peers" could take place among the participants.

As external evaluators, we have adopted a "meta-activity" lens to help make sense of the complexity of socialization and academic plans. Lattuca and Stark's sociocultural model (2009, p. 3) resembles the diagrammatic approach of an activity system. Using this model for external evaluation affords a view of the social construction of activities that can be revisited and reflected upon in ways that the academic planners were unable to do in their conceptual planning. Academic plans are just that, plans. Student agency, the agency of artifacts and tools, and unintended effects from the affordances of learning environments are just a few of the many factors that shape learning processes. External evaluators help in revisiting a conceptual plan that has been put into practice, and in doing so their evaluations can shed light on the cultural and historical forces that both inform and emerge in learning contexts. With these tools, evaluators can engage faculty and staff in reflecting on impactful decision points, a process we argue requires examining instances of joint activity and producing meta-activities that invite faculty and staff to engage in continued reflection.

This "meta" view of activity theory speaks to various scales that converge in and through the external evaluation of an academic plan. In this paper these scales include:

1. *Ethnographic research on joint activities in classroom settings*: The examination of learning activities by observing student-teacher interactions and classroom activities. We further triangulated these qualitative insights by conducting interviews and focus groups with faculty, staff, and students in this program. The data was then compared to the curricular goals of the academic plan.

2. *External evaluation analysis and reporting:* The insights gained from this research became sources for exploring on a meta-level how this data can inform the development of the academic plan over time. It also provided a reflection point for further theorizing

the role that an external evaluator can play in the co-development of transdisciplinary undergraduate learning.

By breaking down the practice of external evaluation in this way, it is possible to examine multi-scalar levels on which cultural and historical forces inform how learning activities on both levels culturally produce knowledge. A meta-activity concept illuminates how scale impacts this process. It also provides a schematic for illustrating how the work of evaluators is integral yet also necessarily separate from this process. External evaluators should critically engage with power dynamics, especially in cases where partnerships with outside organizations, like business and industry, are involved.

It is also important to recognize that external evaluation can be treated as peripheral by faculty and staff. This may in part be because faculty and staff do not fully understand the work being carried out or the programmatic differences that distinguish external valuations from other forms of assessment. For instance, in the program outlined in this case study, the financial commitment made to the evaluators was originally meant to support four continuous years of external evaluation. While this work was meant to be carried out in consultation with the faculty and staff in this program, it was also designed to operate externally, and thus independently from the day-to-day administration of the program.

Yet, the funding for this work was drastically cut after the first year. This cut in funding makes it impossible to have an embedded researcher tracking the program's courses and related educational activities. Rather, the program administrators asked the evaluators to reflect on the design of the program in written reports to the administration and industry sponsor. This shift towards reporting rather than evaluating the program is motivated by the need to both claim credit for the design of the curriculum and to promote the program to outside funders. Both factors are viewed as being more critically important than investing in continuous reflection and development. Therefore, by deconstructing the ideologies and interests behind disinvestment it is possible to expose assumptions rooted in asymmetric power relations, which may in turn lead to false claims about the transdisciplinary scope of the curriculum.

As engineering educators as well as transdisciplinary scholars we see these issues and in particular this case study as mattering to the field of engineering studies because it illustrates how "transdisciplinary" work can be rooted in technological fields. Importantly, it also provides an example of how this workforce context can shape future transdisciplinary thinkers and practitioners through undergraduate education. Finally, it reveals ways in which high-performing students in particular are influenced by academic plans that embed both tacit and intentional decision points.

Conclusion

This paper critically reflects on the implications that an external evaluation of a transdisciplinary academic plan can have towards realizing the transdisciplinary aspirations of the curriculum. Like many similar curriculums that have emerged in the last decade, the curriculum analyzed here is designed to provide students from multiple disciplinary backgrounds with an integrated educational experience. This includes engineering and other technology-centric fields where students are socialized into particular ways of learning about the limits of their field and the possibilities afforded by engaging in what faculty in this degree program call a "systems

approach" for innovating technology that has a social impact. Likewise, students from non-STEM degrees are taught basic engineering concepts as well as the limits of their own disciplinary practices to prepare them to work in engineering contexts on transdisciplinary problems. In the process both groups of students are socialized into particular ways of organizing design projects and interacting with their peers, faculty, and external stakeholders. These social practices range from specialized forms of talk for describing organizing processes to the embodiment of research methods that frame design problems in institutionally recognizable ways—both inside and outside the university.

While these socializing practices are integral to any learning context, they are also highly susceptible to outside influences. These influences have the power to skew the original intentions of curriculum designers and reproduce assumptions about transdisciplinary learning processes, particularly when these assumptions are left unchecked. To this end, external evaluators can play a critical role in the identification of "decision points" as well as in engaging faculty and staff in activities for revisiting and revising curricular goals and practices. But as this case study illustrates, the generation of decision points requires evaluators to juggle multiple forms of activity theories that occur throughout the external evaluation process. This includes the evaluation of curricular activities, which must be examined in terms of how these activities reflect or diverge from the academic plan; conducting research on the curriculum in ways that maintain an evaluators external anonymity; and the work that goes into conveying insights from the evaluation to faculty and staff in both a meaningful and accountable fashion. This work must be taken as integral, rather than peripheral to the development of an academic plan, which the meta-activity theory may contribute.