Themes, Lenses, and Materials: Three Perspectives on HCI Program Development

Colin M. Gray
comgray@iu.edu
Indiana University
Bloomington, Indiana, USA

Austin L. Toombs
altoombs@iu.edu
Indiana University
Bloomington, Indiana, USA

ABSTRACT

As an inter-discipline or trans-discipline, HCI includes or references many different sources of knowledge in which students are expected to be conversant. The education of HCI practitioners requires exposure to an increasingly large number of these perspectives. However, how should this exposure be structured, with what level of depth, and through what metaphors? In this unsolved challenge, we outline the complex range of perspectives required and the limitations of typical curriculum and program design techniques. We then illustrate how HCI educators might use three different perspectives to consider and communicate program complexity to students: 1) content themes; 2) transdisciplinary lenses; and 3) design materials. We conclude with opportunities for HCI educators to leverage these insights to build courses, projects, and other program structures.

CCS CONCEPTS

• Human-centered computing → Human computer interaction (HCI); **• Applied computing → Education**; **• Social and professional topics → Computing education**.

KEYWORDS

HCI education, design knowledge, transdisciplinarity, disciplinarity

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1 INTRODUCTION

HCI has historically been known as a space for interdisciplinary partnership, whereby scholars bring together multiple disciplinary perspectives in an epistemologically pluralistic way to advance human-centered computing work. Numerous scholars have addressed this pluralism in differing ways, with Harrison et al. [13] proposing multiple dominant paradigms in which research and practice can be located, Bødker [3] identifying the presence of multiple overlapping "waves" of scholarship, and Rogers [22] articulating a broad base of classical, modern and contemporary theories upon which HCI scholars can build arguments.

This diversity of perspectives has led to the functioning of HCI as an "inter-discipline" or "trans-discipline" [1, 2]. As these debates raged in the mid 2010s, Blackwell pushed back against efforts from some portions of the community to consolidate core disciplinary themes, instead stating: "CHI should strategically avoid the search for such a core, instead seeking its identity as a mode of responding and contributing to other disciplines" [1]. In this framing, Blackwell argues that HCI scholars should focus on what they do best—engaging with the complex challenges of technical practice, critically engaging with social and technical issues, and identifying opportunities to make interventions that shape future computing advances.

This epistemological diversity is commonplace in HCI scholarship, but what does this diversity look like in HCI educational practices? In the decade since this debate in HCI scholarship, the outcomes of HCI educational programs have become even more diverse—with stronger participation in UX research, product management, and strategically-aligned design work than previous roles which were primarily UX-focused. Additionally, recent technology advances have complicated traditional HCI educational efforts to build "core" knowledge, with the numbers of topics HCI practitioners are expected to be conversant in growing to an unwieldy volume. While there has been interest by various educational researchers in these issues of disciplinary sprawl (e.g., [2, 5, 8, 9, 18]), few of these approaches have been mapped to guide program-level curriculum decisions.

In this unsolved challenge, we outline the complex range of perspectives required and the limitations of typical curriculum and program design techniques. We then illustrate how HCI educators might use three different perspectives to consider and communicate program complexity to students: 1) content themes; 2) transdisciplinary lenses; and 3) design materials. We conclude with opportunities for HCI educators to leverage these insights to build courses, projects, and other program structures.

2 SETTING THE STAGE FOR TRANSDISCIPLINARY HCI EDUCATION COMPLEXITY

Faiola's [5] proposal for an "enterprise model" of HCI education in 2007 is perhaps still the most structured call for transdisciplinary education. In this model, Faiola considers the need for students to have exposure to four different "knowledge domains": social (understanding the complexity of humans and culture); design (dealing with graphics and interaction); business (addressing market value and return on investment); and computing (including perspectives

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on building and testing technical systems). Across each domain, Faiola identified foundational theories, processes to apply these theories, and approaches to manage these perspectives.

In later work building on this model, Gray, Parsons, and Toombs [8] created an integrated studio model of HCI education that brought together specific types of domain knowledge that were then experienced by students in a "spiral" curriculum, allowing students to have multiple points of exposure to key knowledge and skills that would move them towards mastery. They mapped six different knowledge domains with some relationships to Faiola's categories: visual and interactive representation; design philosophy; social/research methods; technical skills; global consciousness; and leadership and teamwork. Gray et al. also proposed the development of *transdisciplinary* competencies as well, advocating for students to be exposed to and conversant in the language of multiple disciplines, including: psychology, anthropology, sociology, philosophy, ethics, technology history, and design history [8]. Branch et al. [4] updated this list of knowledge domains based on a survey of UX and HCI curricula and job ads, resulting in: visual and interactive design; research and evaluation; technical skill; transdisciplinary; and leadership and teamwork. At a slightly higher level, Rose et al. [24] identified technical skills, human skills, and dispositions needed by students in industry based on a large interview study of UX professionals.

Other design educational scholars have focused more generally on issues integrating multiple disciplinary perspectives in a transdisciplinary learning experience. For instance, Varner, Gray, and Exter [7, 26] describe how transdisciplinary learning experiences can be carefully designed to simultaneously integrate multiple *disciplinary* perspectives—considering how a student might engage in design activity through the language of specific disciplines as well as identifying new coherent framings of *combinations* of disciplines to address wicked problems as well. As part of this approach to transdisciplinary pedagogical design, Gray and Exter [7] propose an activity and project framework that articulates specific project goals, activities, reflection, critique that supports these project goals, and links to multiple disciplinary perspectives that enable these activities and outcomes.

Across this prior work on engaging students in transdisciplinary learning experiences, it is clear that the complexity of knowledge types and related pedagogical practices represents a substantial challenge for educators. However, in the spirit of "taming" wicked problems, we propose three different lenses or ways for educators to look at and play around with this complexity [25] rather than seek to standardize curricula or identify best practices for all HCI programs. By using a wide range of approaches to inform the creation of creative program structures, we anticipate that educators will be able to more nimbly address the continuing volatility of HCI and UX disciplines [16].

3 THREE APPROACHES FOR HCI PROGRAM DEVELOPMENT AND EVOLUTION

To address the knowledge complexity of HCI work, we have worked as a group of educators to adapt individual courses and build and evolve curricula on the program level in graduate and undergraduate contexts. We have conducted this design of learning experiences for almost a decade, leveraging our joint expertise in instructional design and studio pedagogy, visual and interactive design, computer science, ethics, and design theory. Colin and Austin's pedagogical experiences include building and iterating upon a novel undergraduate UX program at Purdue University [8, 9, 27] which incorporated vertical integration [21] and engagement with flexible content domains [8]. In addition, Colin also contributed to an undergraduate degree program in transdisciplinary studies [7] which pioneered flexible combinations of disciplinary knowledge set within a studio education framing, including guidance on pedagogical approaches to wrangling this complexity [26]. Colin is currently leveraging these past experience to create the foundation for a revised graduate curriculum in a design-focused HCI Masters program at Indiana University Bloomington.

Through these pedagogical design experiences, we have iteratively developed three different structural approaches through which we can consider, construct, and evaluate HCI curricula. We do not intend for these approaches to be used *instead* of traditional course and program design perspectives, but rather as a series of perspectives through which knowledge complexity, disciplinary diversity, and learner experiences can be productively viewed. We describe each approach in isolation first, and we then provide some examples of how we have engaged these approaches in a synthetic way in our own educational practice in the following subsections.

3.1 Content Themes

Content Themes are areas of declarative, procedural, embodied, or experiential knowledge we wish for students to have competence in when they graduate. These themes build upon scholarship from Gray, Parsons, and Toombs [9] that mapped out six high-level areas of competence and differing types of skills that range from technical to human to mind-set oriented from Rose, Putnam, & MacDonald [24]. In addition, we have leveraged perspectives from industry that propose competencies relevant to professional practice [4, 23] as well as domain specific areas of competence (e.g., methods [6]).

(1) Content themes represent things we want students to know, understand, or experience.
(2) Content themes frequently require multiple forms or types of experience in order to lead towards mastery.
(3) Content themes indicate something we believe students need to know, but it does not indicate how something should be taught or incorporated into the curriculum.

3.1.1 *Examples of Content Themes.*

- **Prototyping and Representation:** Ideation, Fidelity, Manifestations and Filters, Sketching, User Journey and Experience Maps, Task Flows, Microinteractions, Materiality
- **Research and Evaluation:** Research Questions, Research Design, Collection/Engagement Methods (e.g., interview, observation, contextual inquiry, workshop, probe, digital ethnography), Evaluation Methods (e.g., usability testing, heuristic evaluation, deployment study, diary study, experience sampling), Analysis Methods (e.g., affinity diagramming, thematic analysis, content analysis)
- **Leadership and Teamwork:** Mentorship, Decision Protocols, Storytelling, Strategy, Project Management, Facilitation, Critique & Feedback, Documentation

- **Design Theory and Philosophy:** Expertise, Connoisseurship, Knowledge (e.g., experiential, embodied, precedent, declarative), Framing, Judgment, Methods and Tools, Wicked Problems
- **Critical Consciousness:** Design Character, Dark and Bright Patterns, Ethical "Intentions", Sustainability and Social Impact, Legal and Regulatory Frameworks, Values, Feminism and Social Justice

3.2 Transdisciplinary Lenses

Transdisciplinary Lenses are perspectives through which knowledge has been built or can be activated in which we wish students to be conversant. These themes build upon scholarship beginning with Faiola's Enterprise Model for HCI Education [5], which was extended for a generic transdisciplinary studio education model by Varner et al. [26] and Gray and Exter [7]. In particular, we extend Gray and Exter's model of transdisciplinary competence, including component skills in recognizing the epistemological limits and opportunities of specific disciplinary perspectives. We also built on Gray, Parsons, and Toombs' [8] account of how students can build competence from a range of different disciplinary perspectives to build their own identity as an HCI designer. All of these perspectives view disciplines as perspectives and material to think with and through in an additive sense, recognizing that HCI professionals must simultaneously understand and utilize knowledge that has a distinct disciplinary origin (e.g., human cognition, social norms and behaviors, technical sensing) and also recognize new coherence across multiple, often conflicting knowledges from multiple disciplines.

(1) Transdisciplinary lenses are perspectives for students to think with and through about a design problem.
(2) Transdisciplinary lenses require at least a baseline understanding of how a discipline creates and uses knowledge and the constructs they rely upon.
(3) Transdisciplinary lenses are used in combination, since our goal is for students to use disciplinary knowledge as a way to understand and transform their design context. (i.e., different lenses may yield different, often conflicting, understandings of what is important in a given design space)

3.2.1 *Examples of Transdisciplinary Lenses.*

- **Society and Human Behavior:** Anthropology, Cognitive Science, Psychology, Sociology, Education
- **Critical and Cultural Viewpoints:** Cultural Studies, Media Studies, Critical Theory
- **Technical and Formgiving:** Engineering, Industrial Design, Architecture, Studio Art
- **Historical Perspectives:** Art and Design History, Social and Cultural History

3.3 Design Materials

Design Materials are ways of looking at or structuring design activities, including philosophical or theoretical commitments, material properties and types, and attitudes towards representations or outcomes. These categories of materials build on general work in materiality and HCI (e.g., [12, 15]) as well as contemporary work on viewing artificial intelligence [14], machine learning [28], or (meta)data [17, 19] as design material. The focus of these efforts is in viewing conceptual or theoretical perspectives as having formgiving properties that encourage certain kinds of bounded exploration, similar to different physical materials that might have particular capabilities and opportunities for expression (e.g., the pliability of clay versus the permeability of sand).

- Design materials are ways for students to work with, approach, and mold a problem space.
- Design materials each have different properties that foreground some elements of the design situation while backgrounding others.
- Design materials involve disciplinary competence (e.g., data science to understand what is manipulatable in AI/ML) but focus on future states.

3.3.1 *Examples of Design Materials.*

- **Data**: AI and ML, Information Architecture (AI), Data-Driven UX (DDUX)
- **Philosophies:** User-Centered Design, Human-Centered Design, More-than-Human Design
- **Action Orientations:** Participatory Design, Co-Design/Co-Creation, Feminist HCI, ICT4D, Ability-Based Design
- **Core HCI Theories:** Affordance, Gulfs of execution and evaluation, Distance Matters, Cognitive Modeling, Socio-technical gap
- **Domain-specific Theories:** Embodied and Extended Cognition, Learnability, "Training Wheels", and Onboarding
- **Culture and Identity:** Intersectionality; Cross-Cultural Design; Design Ecologies
- **Patterns and Systems**: Design systems; Pattern libraries

4 PUTTING THE APPROACHES INTO ACTION

While these approaches are described at a relatively high level, we have used versions of these approaches in the past as creative stimuli to consider various aspects of program complexity and design new program and course-level structures in response. We cannot fully articulate all of the underlying decisions that informed each of our program-level decisions (see [7, 9] for additional detail), but these examples may be a useful starting point for HCI educators considering changes to their program offerings.

4.1 Program Planning

Building upon Gray and Parsons' [10] approach to mapping methods competence across the curriculum, these different approaches have been useful for us to consider which elements we want for students to experience *somewhere* in the curriculum, how much complexity we want them to experience (and at what time), and how students can map this complexity and elements in their own mental schema.

This involves creating consistent metaphors across multiple courses within the program curriculum that are readily identifiable to students. For instance, socializing the concept of a design material might have a substantial instructional cost in terms of time and resources early on in a curriculum, but then can be effectively leveraged in all downstream coursework.

- *Content Themes* allow consideration of the net volume of total "knowledge" educators expect students to be exposed to during the entire program. This might include mappings of specific content themes across multiple courses, frequency and duration of exposure, and assessment methods or other mechanisms used to ensure mastery or a particular level of familiarity. As an example from our own experiences, we have incorporated "prototyping and representation" as content themes that should exist across multiple courses in an HCI program, rather than as a set of skills a student should learn within a particular course. By identifying when in the curriculum students are introduced to varying levels of prototyping and representation complexity, we are able to adjust expectations for how strongly students should be able to incorporate prototypes and representations in their projects.
- *Transdisciplinary Lenses* allow consideration of which disciplinary perspectives students should be familiar with, conversant with, and able to combine in various configurations to address particular types of HCI challenges. This might include particular dominant desired philosophical commitments (e.g., an emphasis on combining cognitive and critical approaches) or orientation towards specific job roles (e.g., emphasizing anthropological and sociological perspectives as a way of preparing students for careers in UX research).
- *Design Materials* allow consideration of the range and depth of material perspectives students can bring to bear in their design processes and outcomes. This might include a curricular philosophy that values very broad exposure to HCI outcomes (e.g., screen-based, service, cross-channel, embodied, physical) or areas where there is greater desired depth (e.g., a primary focus on UX/UI outcomes or a focus on human-centered AI).

4.2 Course (Re-)Development

When developing a new course or redeveloping an existing course, these approaches provide a way to structurally identify which types of content, lenses, or materials should be included in the course. What themes, lenses, and materials are students already familiar with that we can leverage and extend? Which elements might be entirely new? For instance, students in an intermediate project-based course might already be familiar with a usability-centric view of evaluation that primarily draws on cognitive and experimental disciplinary perspectives in HCI. Educators could consider whether the goal is to extend that current view of disciplinary evaluation strategies or challenge students to consider differing perspectives on evaluation that might exist in the broader transdisciplinary HCI space. Questions to consider when redesigning such a course include: How might design materials relating to culture and identity or different attitudes towards action orientation bring new awareness of the gaps in the usability-centric paradigm of understanding or mapping user behavior? When is it appropriate to leverage critical consciousness-oriented content themes to better understand issues relating to context-specificity or social impact? And how might cognitive disciplinary perspectives be challenged by the introduction of disciplinary knowledge and practices from anthropology or cultural studies? The answers to these questions would need to ensure that the redesigned course components continue to support the content, lenses, and materials required in future portions of the program as well.

We have recently engaged in this type of planning to adapt our courses to the rapidly expanding role of AI in HCI and UX design. For example, to encourage our students to think about AI as a design material, we first had to consider if this group of students had previously introduced to thinking about design materials in a more abstract or critical way. If, for example, the students had previously only been asked to engage with specific design materials at a time, but they had not been encouraged to think about what it means to consider something *as* a design material, then we would need to make time in class to explain that type of thinking. Otherwise, with a complex material like AI, students would be limited to thinking about what AI can already do for them or how they have already used it, and not as much about how they could leverage AI in a design the way they would leverage color, spacing, form, etc. For the week when we discuss AI in the course we redesigned, we dedicated one of the days to discussing what it means to say that AI is a design material and engaging with an activity where they examine two products that use AI and discuss those products using a set of guiding questions we provided to them. For the second day of class, we encouraged students to find articles about AI in HCI design online (where "article" could mean a wide range of online content, including extended discussions found on social media). We then guided the students through a discussion about those articles that highlighted the way those articles discussed the materiality of AI or the use of AI as a design material.

4.3 Evaluation and Benchmarking

Even if the goal is not primarily to develop or extend curricula, the approaches also have value in evaluating the current state of curricula and benchmarking it across institutions or across research and practice contexts. This evaluative work might be driven by a desire to ensure job readiness (as framed by Rose et al. [24] and Branch et al. [4]) or as a way of considering how HCI professionals should be prepared to (re-)shape the discipline moving forward. In this evaluative mode, directionality is critical. One could take Branch et al.'s approach to see what skills and knowledge is desired by industry professionals through job ads. However, this could lead to a lack of understanding of what might currently be missing, or expression of skills, mindsets, or knowledge that are undervalued yet important. By only applying benchmarking from education to industry, one can also introduce substantial blindspots due to the lack of clear knowledge translation in many areas of the research-practice divide [11, 16]. For instance, while practitioners might not use the language of the "socio-technical gap," there is a general awareness that technical solutions that do not address social causes or realities are likely to fail.

Thus, benchmarking or evaluation would ideally be conducted across educational programs or between education and industry in a bi-directional manner. What are HCI practitioners being asked to do that are not covered in existing curricula (or are not well mapped across the translational gap or that may not be appearing in the job ads we have access to)? What do HCI practitioners need to be able to do to have power within organizations, including shifts in job roles and responsibilities? What should HCI practitioners know about how to challenge capitalist and industry norms that might not be desirable to industry, but would be a net positive for society?

5 CONCLUSION

In this unsolved challenge paper, we have outlined three different approaches to structure HCI program development: 1) identifying *content themes* that can exist within courses or across a program structure; 2) mapping *transdisciplinary perspectives* that students can use as lenses to make sense of the complexity of HCI work; and 3) utilizing differing kinds of knowledge and concepts as *design material* to flexibly engage with and build new design outcomes. We illustrate opportunities to put these approaches into practice through program-level planning, course development or re-development, and evaluation and benchmarking. These approaches also serve as a potential foundation for further HCI pedagogical research, including the development of pedagogical content knowledge (PCK) across the curriculum [20], considerations for current and future industry volatility [4, 16], and identification of aspects of the learner experience that these approaches might elucidate and support [7, 9].

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