BILLIONS OF INTERACTION DESIGNERS[1]

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ABSTRACT:

This paper takes up notions of and a vision for interaction design education. The basis of the paper includes reflection based on combined years of teaching experience by the authors both in design schools and in HCI-oriented programs of study and in hybrids of the two, as well as classification of two such programs in terms of a frame we describe and attribute in what follows. The larger intended goal is to overcome the guild-like thinking of much of design pedagogy, in order to make design learning a foundational form of learning and mode of being at great scale, in the interest of broad societal benefits. The more modest goal is to share notions of curriculum, with the intention of creating a basis for shared understanding of how interaction design may be taught.

INTRODUCTION

In an article titled "The Three Paradigms of HCI," Steve Harrison, Deborah Tatar, and Phoebe Sengers (2007) give an account—attributed in partial inspiration to Malcolm McCullough—of how the field of Human-Computer Interaction (HCI) can be interpreted in terms of three "waves" or "paradigms" which correspond roughly historically to how HCI has developed in terms of the academic disciplines that have most prevailed as inputs to its pluri-disciplinary character. In our conceptualization, we add yet a fourth wave, which we intend primarily as an instrument for understanding curricular organization, and only secondarily as a thesis about what is and what is not already represented within each of the respective three waves of HCI as Harrison, Tatar, and Sengers describe. The three waves described by Harrison, Tatar, and Sengers are—in simplified naming—the (i) *technical paradigm* or first wave (W1), the *cognitive paradigm* or second wave (W2), and the *ethnographic paradigm* or third wave (W3). To this we add a fourth, namely the *transdisciplinary design paradigm* or fourth wave (W4). The interchangeability of the terms "paradigms" and "waves" are by now conventions of the discourse in HCI. The notion of "third wave HCI" owes in our reading to Bødker (2006), wherein it is more broadly traced and attributed.

The naming of paradigms or waves and associated related disciplinary methods and expertise has both utility and danger. On the positive side, these distinctions help articulate the varying expertise of faculty engaged in teaching HCI and interaction design—the distinctions afforded by named paradigms are at least a possible frame for understanding what needs to be taught for the curriculum to be complete and neither overloaded (with skills that may not be necessary for students) nor under-loaded (by failing to present varying paradigmatic perspectives coherently). On the negative side, when naming paradigms or waves, there is a risk that people may interpret these more qualitatively than is desirable, reinforcing old silos, reifying disciplinary parochialism, creating arguments about how many named paradigms are the optimal count, or creating arguments about what sort of knowledge is dominion to which particular paradigm, when in fact there are many overlaps. Needless to state, our goals are the positive ones and not the negative.

THEORY PART I: FOUR WAVES AS CURRICULAR ORGANIZATION

In this section, we describe the four waves in terms of a frame targeted at curricular organization. For each of the waves, we provide a definition, we characterize the types of skills involved, and we

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characterize as well the core competencies that interaction design students need to acquire. As described above, these waves or paradigms are inspired in large part by Harrison et al. (2007), to serve as a foundation for our curricular descriptions in what follows. While inspired in large part by this source, our framing has some few nuanced differences. For example, we give the paradigms names, rather than referring to them as paradigm one, paradigm two, and paradigm three.

W1 TECHNICAL PARADIGM (FIRST WAVE HCI/ID)

The technical paradigm may be defined as a focus on expertise concerning interactivity and digital technologies as *materials of design* (see Löwgren & Stolterman, 2004; Blevis & Stolterman, 2008, 2009). The kinds of curricular matter associated with the technical paradigm within an interaction design program may include skills-training in HTML/CSS, wire-framing, methods such as use case analysis, pattern languages, application prototyping, information architecture, tangible computing as with Arduino and so forth. As a matter of core competence, students learn how to understand new technology developments much in the same way that an architect needs to understand the possibilities and limitations that new materials present, as well as being able to predict which materials and technologies will become available in 2, 5, 10, and 20 years of time

W2 COGNITIVE PARADIGM (SECOND WAVE HCI/ID)

The cognitive paradigm may be defined as a focus on understanding how people understand digital materiality as a matter of informing the design of interactivity. The kinds of curricular matter associated with the cognitive paradigm within an interaction design program may include skills-training in interviews, surveys, behavioral prototyping, usability studies, "user" experience studies, empiricism, and so forth. As a matter of core competence, students learn how to study and characterize human cognitive models and the mappings between human cognitive models and technology operational models as a matter of improving design usability and experience.

W3 ETHNOGRAPHIC AND CRITICISM PARADIGM (THIRD WAVE HCI/ID)

The ethnographic (see for example, Dourish, 2006) and *interaction* criticism (see for example, Bardzell & Bardzell, 2013) paradigm may be defined as a focus on understanding and describing human experience as a form of interaction design research and interaction design in-and-of-itself. The kinds of curricular matter associated with the ethnographic and criticism paradigm within an interaction design program may include skills-training in ethnographic methods including photo-ethnography, observations, collections (i.e. curatorialism), critical theories (i.e. feminism, ontological design, reflective practice, activity theory, practice theory), and so forth. As a matter of core competence, students learn how to endow interactive forms with meaning and content and interpret interactivity as a matter of meaning and content.

W4 TRANSDISCIPLINARY PARADIGM ("FOURTH" WAVE HCI/ID)

The transdisciplinary (see for example, Max-Neef, 2005; Nicolescu, 2002) paradigm may be defined as a focus on insisting on a values-orientation for interactivity design as a higher order concern than particular collections of methods or domains of expertise. The kinds of curricular matter associated with the transdisciplinary paradigm within an interaction design program may include skills-training in design frameworks, values and ethics, design for important themes such as sustainability, equity, adaptation, justice, social responsibility, and so forth. As a matter of core competence, students learn how to bring a values-orientation to interaction design and explanation of interaction design.

To justify the distinction between W4 and W3, which are not distinguished as separate waves in Harrison et al. (2007), we would argue that it is in fact **not** possible to undertake a focus on any of the waves in a purely politically-neutral, values-neutral way, teleological way—neither technical, nor cognitive, nor ethnographic/interaction criticism paradigms. At the same time, values, ethics, and politics are not the primary *foci* of these first three waves. Thus, we argue that transdisciplinary design is distinguished from the other paradigms by its primary cardinality of focus on politics and values and ethics. This focus may be present and certainly must be ideally

present in the actual practices of the other waves, but it is not necessarily so as a matter of the fact of practices.

All that is above is summarized in Table 1.

Paradigm	*Competency/ Learning Outcome*	*Examples of Related Skills*
W1 Technical Paradigm	Students learn how to understand new technology developments much in the same way that an architect needs to understand the possibilities and limitations that new materials present, as well as being able to predict which materials and technologies will become available in 2, 5, 10, and 20 years of time	HTML/CSS, wire-framing, methods such as use case analysis, pattern languages, application prototyping, information architecture, tangible computing as with Arduino and so forth
W2 Cognitive Paradigm	Students learn how to study and characterize human cognitive models and the mappings between human cognitive models and technology operational models as a matter of improving design usability and experience	interviews, surveys, behavioral prototyping, usability studies, "user" experience studies, empiricism, and so forth
W3 Ethnographic and Criticism Paradigm	Students learn how to endow interactive forms with meaning and content and interpret interactivity as a matter of meaning and content	ethnographic methods including photo-ethnography, observations, collections (i.e. curatorialism), critical theories (i.e. feminism, ontological design, reflective practice, activity theory, practice theory), and so forth
W4 Transdisciplinary Paradigm	Students learn how to bring a values-orientation to interaction design and explanation of interaction design	design frameworks, values and ethics, design for important themes such as sustainability, equity, adaptation, justice, social responsibility, and so forth

Table 1. Paradigms, Learning Outcomes, and Characteristic Skills

PRACTICE: HUMAN-COMPUTER INTERACTION DESIGN (HCI/D) AT INDIANA UNIVERSITY

The theoretical framework above is used as an organizing structure for the Master of Science, Human-Computer Interaction Design program at Indiana University in Bloomington USA. This two year program has approximately 40 students in each single year cohort. Demographically, using the 2013 cohort as an example, the program is roughly (i) 50% international and 50% American, (ii) 50% women and 50% men, and (iii) 10% African American. The international students come primarily from China (mainland), India, and some fewer from Europe, Scandinavia, and South America. The faculty have national origins in Canada, Taiwan, Sweden, and USA (4). The program was founded in 2002, and has evolved over time to arrive at the curriculum as described in what follows.

Table 2 shows the courses that comprise the MS degree and for each course, the emphasis in terms of the four curricular waves is described in terms of primary and secondary emphases. The data in the table are ascribed by the program director, based on knowledge of the content of each course. From the diagram, one can see a balance of the different waves, however the ethnographic and critical third wave is more represented in keeping with the design-orientation of the program—indeed, within HCI, the program at Indiana is known as *the* design-oriented HCI program. Importantly, the four waves theory does not necessarily characterize everything that is covered in these courses—recall that it arises out of an historical account of HCI augmented to include notions of transdisciplinary design as the fourth wave, and HCI does not include everything that is covered in the curriculum. For example, it is hard to place enterprise-centered notions of design strategies within the four waves as described above, and design strategies is a course in the curriculum as shown in the table, presently taught by faculty with MBA qualifications.

Course name	*W1*	*W2*	*W3*	*W4*
Interaction design practice	●	○		
Foundations of HCI/d			●	○
Meaning & Form			○	●
Methods		●	○	
Experience design		●	○	
Prototyping	●	○		
Design Theory			●	○
Rapid Design	●	○		
Design Strategies	○			●
Interaction Culture			●	○
Participatory Design			●	○
Thesis	○	○	○	○

Table 2. HCI/d Program at IU: Waves to Courses (W2C)
● : primary emphasis | ○ : secondary emphasis

Table 3 shows the faculty core competencies in terms of their present research and scholarship foci, again as ascribed by the program director. Although all of the four waves are represented in terms of these foci, the third and fourth waves are more significantly represented. Other HCI programs would be better known for their technical and cognitive paradigm foci, and the table shows that these are not the foci of the Indiana faculty. Similar to the courses, it is important to note that the four waves do not necessarily characterize every competence of the faculty. Moreover, these ascriptions of faculty competence refer to the present circumstance at time of writing—many faculty change their primary and secondary foci over time. All but one of the faculty in the program are appointed.

Faculty competencies	*W1*	*W2*	*W3*	*W4*
(SB) Bardzell, S		○	●	○
(JB) Bardzell, J		○	●	○
(EB) Blevis	○		○	●
(MS) Siegel	○	●	○	
(ES) Stolterman	○		●	○
(NS) Su		○	●	○
(TB) Brown	○	○		●

Table 3. HCI/d Program at IU: Faculty Competencies to Waves (FC2W)
● : primary emphasis | ○ : secondary emphasis

Table 4 shows an important utility of the four wave theory in terms of curricular organization. Combining Tables 2 and 3 allows one to see the likely way in which courses may be assigned to the faculty, how many faculty are qualified and/or inclined to teach each course, and where the system is brittle in terms of dependency on particular, uniquely focused faculty.

Course name	*W1*	*W2*	*W3*	*W4*	*Faculty*
Interaction design practice	●	○			MS
Foundations of HCI/d			●	○	JB, EB
Meaning & Form			○	●	EB, JB
Methods		●	○		NS, SB, ES
Experience design		●	○		NS, SB, ES
Prototyping	●	○			MS, SB
Design Theory			●	○	JB, EB, SB, ES, NS
Rapid Design	●	○			MS, SB
Design Strategies	○			●	TB
Interaction Culture			●	○	JB
Participatory Design			●	○	JB, SB
Thesis	○	○	○	○	SB, JB, EB, MS, ES, NS, TB

Table 4. HCI/d Program at IU: Courses to Possible Faculty (C2PF)
● : primary emphasis | ○ : secondary emphasis

PRACTICE: INTERACTION DESIGN AT THE HONG KONG POLYTECHNIC UNIVERSITY SCHOOL OF DESIGN

The four wave paradigm theory described above was not specifically used as an organizing structure for the Master of Design (MDes) Interaction Design program at the School of Design of the Hong Kong Polytechnic University (PolyU), as it is presently constituted. Nonetheless, it is possible to apply a *post-hoc* analysis to the program similar to the Indiana University example. The result of doing so highlights some of the differences and similarities between the two programs. The PolyU program occurs in a single year, covering 3 semesters, September through mid-July. There are approximately 16-20 students in a cohort. Demographically, using the 2012 cohort as an example, the program is roughly (i) 60% Chinese (primarily mainland, with a single student from Hong Kong) and 40% international, (ii) 50% women and 50% men. The international students in that particular year come from Italy, Columbia, Qatar, South Korea, and Canada (2). The faculty have national origins in Hong Kong (5), Canada, USA (2), Finland, and England.

Table 5 shows the courses that comprise the MDes degree and for each course, the emphasis in terms of the four curricular waves is described in terms of primary and secondary emphases. The data in the table are ascribed by a past acting program director, based on knowledge of the content of each course and descriptions by the present program director [as publically presented] and a senior rank administrator. From the diagram, one can see that all of the waves are

represented in the curriculum, however the technical wave is more represented in keeping with the production-oriented design-orientation of the program—so for example, every demonstration project at the PolyU is required to have some sort of significant prototype, whereas in the IU program, it is possible and regularly occurring practice to accept design-ethnographic research, or a strategic design plan, or design-theoretic scholarly writing as the outcome of the final thesis deliverable. As with the previous example, the four waves theory does not necessarily characterize everything that is covered in these courses—recall that it arises out of an historical account of HCI augmented to include notions of transdisciplinary design as the fourth wave, and HCI does not include everything that is covered in the curriculum.

Course name	*W1*	*W2*	*W3*	*W4*
Research & Analysis for Design (3)		○	●	○
Vision and Change (1)			●	○
Graduate Seminar I: Theories in Interaction Design (2)		●	○	
Graduate Seminar II: HCI (2)	●	○		
Information Architectures & Visualization (2)	●	○		
Graduate Studio Workshop I (3)	○	●		
Graduate Studio Workshop II (3)	○		●	
Prototyping & Scripting (3)	●	○		
Tangible Interaction Workshop (2)	●	○		
Embedded Interaction Workshop (3)	●	○		
Concept Workshop (1)			●	○
Demonstration Project (5)	○	○	○	○

Table 5. Interaction Design Program at PolyU: Waves to Courses (W2C)
● : primary emphasis | ○ : secondary emphasis

As in the previous example, table 6 shows the faculty core competencies in terms of their present research and scholarship foci, again as ascribed by the prior acting program director. The faculty below the line in the table are visiting faculty, and those above the line appointed. Looking only at the appointed faculty, the emphasis is on first and second wave paradigms. Looking at all of the faculty, there is a very balanced representation of the four waves. The focus of the appointed faculty makes sense in the service of the production-orientation of the program, as it is presently constituted. As stated in the previous example, it is important to note that the four waves do not necessarily characterize every competence of the faculty. Moreover, these ascriptions of faculty competence refer to the present circumstance at time of writing—many faculty change their primary and secondary foci over time.

Faculty competencies	*W1*	*W2*	*W3*	*W4*
(KC) Chow		●	○	○
(CC) Choy	●	○	○	
(PC) Chuah		●	○	
(TL) Luximon	○	●	○	
(HW) Wei	○	●	○	
(EB) Blevis	○		○	●
(MF) Fox	●	○	○	
(IK) Koskinen		○	○	●
(SP) Poggenpohl		○	●	○
(DW) Williams	○	●	○	

Table 6. Interaction Design Program at PolyU: Faculty Competencies to Waves (FC2W)
● : primary emphasis | ○ : secondary emphasis

Also, as in the previous example, table 7 shows the utility of the four wave theory in terms of curricular organization. Combining Tables 2 and 3 allows one to see how the courses may be assigned to the faculty, how many faculty are qualified to teach each course, and where the system is brittle in terms of dependency on particular, uniquely focused faculty.

Course name	*W1*	*W2*	*W3*	*W4*	*Faculty*
Research & Analysis for Design (3)		○	●	○	KC, PC, IK, SP, EB
Vision and Change (1)			●	○	KC, IK, SP, EB
Graduate Seminar I: Theories in Interaction Design (2)		●	○		KC, EB
Graduate Seminar II: HCI (2)	●	○			TL, HW, MF
Information Architectures & Visualization (2)	●	○			TL, HW, KC
Graduate Studio Workshop I (3)	○	●			TL, HW, KC, DW
Graduate Studio Workshop II (3)	○		●		TL, HW, KC, DW, SP
Prototyping & Scripting (3)	●	○			TL, HW, CC
Tangible Interaction Workshop (2)	●	○			TL, HW, MF
Embedded Interaction Workshop (3)	●	○			TL, HW, MF
Concept Workshop (1)			●	○	KC, IK, SP, EB
Demonstration Project (5)	○	○	○	○	KC, TL, HW, EB, MF, IK, SP, DW, PC

Table 7. Interaction Design Program at PolyU: Courses to Possible Faculty (C2PF)
● : primary emphasis | ○ : secondary emphasis

THEORY PART II: REFLECTION ON THE FOUR WAVE PARADIGM TABULATION AS A METHOD

In what precedes, we have presented the four wave paradigm and given two examples of interaction design programs, selected because they are familiar to the authors. For each example, we provided a matrix illustration of (i) course content in terms of the waves (W2C), (ii) faculty competencies in terms of the waves (FC2W), and (iii) possible faculty per course in terms of the waves (C2PF). Producing these tables and looking at the patterns that emerge constitute a method for characterizing interaction design programs, as an analysis of their focus, and as a means of comparison between one program and another. In this paper, we present only these two examples. In future work, to which we or others may contribute, the method shows enough promise to warrant application to other HCI and/or interaction design programs, as a means of comparison between programs. The method also provides a means for understanding a program's internal focus, as a tool for reflecting on the degree to which a program aligns with its values and vision, and to which it has the faculty resources to carry out its mission.

Importantly, we argue that the method here has the aforementioned utility. It is not the only method one can use to articulate and assess an interaction design program.

THEORY PART III: TELEOLOGICAL INTERACTION DESIGN AND ONTOLOGICAL INTERACTION DESIGN

The utility of the four wave framework is in part a means to avoid a centrality of teleological, positivist notions of interaction design. While programs of study in interaction design can emphasize "making things," it is important to be thoughtful, especially in terms of transdisciplinary thinking, about what are the ontological implications of what we make, or indeed "unmake." What we mean by this is that interaction designers may regard ideas of eliminating interactivity as sound possible outcomes of design—for example, designs which encourage people to find real, meaningful friendship in the real world rather than less meaningful, discounted friendship in online social networks may be a first class result of interaction design. This notion is bundled in the idea of ontological design. The notion of ontological design was first introduced within HCI in Winograd and Flores (1987), and see also Willis (2006). The point we raise here concerns the tension of emphasis between the design of things within economic frames that involve ever-increasing consumption and externalities (see for example, Friedman, 2013; Fry, 1999; Papanek, 1985), and the design of sustainable lifestyles as a cardinal goal of interaction design.

We are not here arguing that making things is unimportant. We are arguing that being thoughtful about what to make and the implications of making are of central concern. Indeed, making and

thinking are to some degree inseparable actions. In an ideal world, interaction design students would master the skills and competencies associated with each of the four waves. As a practical matter, programs of study need to work with the faculty and students and resources at hand to focus on what is practical for the particular circumstances. The two programs we describe above have different faculty foci, different student demographics and class sizes, and especially very different resources to scaffold research and/or production.

A FINAL REFLECTION: TWO SENSES OF SCALE

The ambitious title "Billions of Interaction Designers" refers, as we stated as the outset, to an ambition to make design learning a foundational form of learning and mode of being at great scale, in the interest of broad societal benefits. The notion of the four waves scaffold this notion of scale in terms of intellectual breadth for curricular composition, and this is the sense of the term *scale* that prompts the title. In this sense, training interaction designers with broader notions of values-oriented transdisciplinarity in addition to notions of ethnography, cognition, and technology is targeted to yield broader societal benefit, as the designs they create are ontologically engaged in promoting and affording positive lifestyles for everyone.

There is another sense of the term *scale* which is important and more common. What is more problematic for interaction design is the relatively small scale numbers under which design education operates. Classes of 16-20, or even 40, are rewarding for faculty and students, affording the attentions that can yield near 100% and even 100% completion rates. As we write this, the advent of massive open online courses (MOOCs) are at the very least prompting discussions about the future of higher education practices. For the moment, the completion rates for MOOCs are so low (less than 10% by any account, and much less by some accounts), that even disciplines which maintain traditional lecture based programs of study are not presently threatened. The affordances of design's predominantly studio-based learning makes the possibility of scale in numbers by means of distance education technologies—of which MOOCs are just the latest instantiation—seem a limited possibility. Nonetheless, the issue of if and how to scale up interaction design education to be a part of basic education for everyone is an open question that we in the profession of interaction design education cannot ignore. Becoming clear on how we can methodically articulate what constitutes and motivates interaction design education is a necessary step in answering this question. This paper is a modest step in that direction.

POST-SCRIPT: INVITATION

Do you direct or teach in an Interaction Design program? If so, we invite you to contact us to participate in future refinements and augmentations of the content of this article to describe the actual practices in Interaction Design programs, more broadly and comprehensively. Please write to the authors. We would be delighted to include you and your description of the practices and relations to epistemological underpinnings of your program in future expanded versions of this article. Our approach is not to conduct surveys, but rather scaffold a broadly-based collaborative reporting of experts.

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