A Practice-Led Account of the Conceptual Evolution of UX Knowledge

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ABSTRACT

The contours of user experience (UX) design practice have been shaped by a diverse array of practitioners and disciplines, resulting in a diffuse and decentralized body of UX-specific disciplinary knowledge. The rapidly shifting space that UX knowledge occupies, in conjunction with a long-existing research-practice gap, presents unique challenges and opportunities to UX educators and aspiring UX designers. In this paper, we analyzed a corpus of question and answer communication on UX Stack Exchange using a practice-led approach, identifying and documenting practitioners' conceptions of UX knowledge over a nine year period. Specifically, we used natural language processing techniques and qualitative content analysis to identify a disciplinary vocabulary invoked by UX designers in this online community, as well as conceptual trajectories spanning over nine years which could shed light on the evolution of UX practice. We further describe the implications of our findings for HCI research and UX education.

CCS CONCEPTS

• **Human-centered computing** → **Empirical studies in HCI**; • **Social and professional topics** → **Computing occupations**.

KEYWORDS

User experience; UX design; Q&A; Stack Exchange; design practice; practice-led research

1 INTRODUCTION

The concept of user experience (UX) has existed for decades, but has only recently begun to garner attention from industry, evidenced by high job demand, and academia, evidenced by increasing numbers of UX-related degrees at the undergraduate and graduate levels. Thus far in its development, UX has lacked what can be considered a coherent body of disciplinary knowledge [41, 60], and there is not a concrete path to become a UX professional, as opposed to more traditional disciplines in science or engineering. Consequently, both junior and senior UX designers face unique challenges in developing and maintaining their UX design knowledge over time [11, 24, 29], particularly as technologies, tools, and UX concepts continue to rapidly evolve.

The shifting state of UX knowledge and its sources creates challenges for not only practitioners, but also academic researchers and educators. Both parties have an interest in identifying, characterizing, and consolidating UX knowledge, albeit for different aims: practitioners wish to guide and enrich their practice [60], while academics wish to build a richer understanding of design practice [28, 44]. Both sets of activities have the potential to productively contribute to an organic, sustainable way of producing and distributing UX knowledge. These knowledge challenges are further enlarged by the research-practice gap, manifested in the lack of recognition and adoption of research results among practitioners [21, 28, 57], and the lack of direct applicability of research to practitioners' everyday design problems [61].

In efforts to overcome these knowledge challenges, practitioners increasingly rely upon online resources such as social media and online community interactions to learn and share design knowledge (e.g., [26, 53, 65]). Design researchers have also called for more attention to understanding practitioners' *actual* design practices [60] in a practice-led framing [44], bubbling up knowledge from their work to shape the

development of academic research [28]. At the intersection of these two forces, we consider UX designers' online communication to be a valuable resource in recognizing and characterizing UX knowledge, with potential utility in both UX research and education.

In this paper, we focus on community interactions in a UX question and answer (Q&A) online community, the UX site within Stack Exchange, which is dedicated to documenting accurate depictions of UX knowledge. We used a mixed-methods approach, including natural language processing and qualitative content analysis, to collect and analyze nine years of Q&A communication to answer two research questions:

1) What concepts and knowledge categories could characterize this body of UX knowledge?

2) How has the UX knowledge shared on this site evolved over time?

The contributions of this paper are three-fold, and include: 1) a detailed, practice-led account of organic UX knowledge sharing practices in a particular online community, greatly extending the current boundaries of practice-led design research literature; 2) a systematic documentation of UX knowledge types that have been shared over time, resulting in conceptual trajectories that may be useful in informing a coherent body of UX knowledge and its potential for impact on UX practice and pedagogy; and 3) an analytic method for generating knowledge from a practitioner interactions in an online community that may be adopted to further study a range of design and creative disciplines.

2 USER EXPERIENCE AS AN EMERGING DISCIPLINE

The core idea of user experience has existed for decades [45]. However, UX has only recently received wide attention in terms of increasing job demand in the industry [15, 35] and rising searches reported in Google Trends (see Figure 1 that shows the worldwide search frequency of "UX design" over time. The emergence of UX can be attributed to multiple factors, including the increasing ubiquity of technologies in everyday life, and increasing attention to users' interactive experience, which exceed the focus of existing and related disciplines such as marketing, graphic design, interaction design, or product design [9, 30]. More recently, the incorporation of UX into digital and physical products has also been considered to be a strategic advantage that addresses design and business interests [16].

UX is inter- and trans-disciplinary, drawing from many disciplinary perspectives in order to identify and solve problems, while generating new knowledge relating to users and use contexts [6, 36, 46]. The UX discipline has absorbed a wide range of knowledge, theories, and methodologies from disparate disciplines such as computer science, engineering,
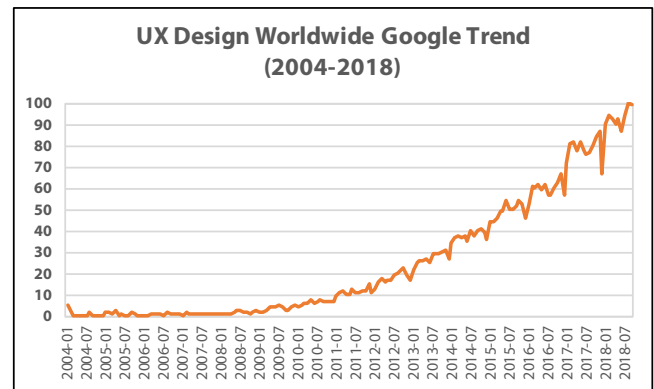

Figure 1: Worldwide search of "UX Design" on Google from 2004-2018 (interest represented on a scale from 0 to 100).

sociology, and psychology [18], resulting in a fusion of interests related to interaction and service (e.g., [6]). Hassenzahl and Tractinsky [30] argue that "UX is about technology that fulfils more than just instrumental needs in a way that acknowledges its use as a subjective, situated, complex and dynamic encounter. UX is a consequence of a user's internal state, the characteristics of the desired system and the context within which the interaction occurs." Law et al.'s survey study [48] among 275 UX researchers and practitioners concur with this view of UX as a discipline that engages with dynamic, context-dependent, and subjective problems. The range and diversity of disciplinary interests and outputs present in UX practice reflect the occupation's emerging state and its potential future growth of influence as a third or fourth order of design [9, 41].

User experience (UX) design has been claimed as a strategic advantage in knowledge-based companies, with Fabricant positing in 2013 that "[t]he value of UX as a corporate asset is no longer in question" [16]. A 2014 report shows that companies that adopted design as a business tool, often with UX as a key underlying commitment, outperformed the S&P by 228% over nine years [64]. Many companies have incorporated UX into their corporate culture, ranging from lean UX to customer-driven to R&D-based UX [16]. Technology organizations such as HP and Intel have been working to develop a design-first strategy for multiple years, while some like IBM have more recently created company-wide design initiatives that have a strong UX focus [22]. Although Fortune 500 companies have begun to recognize the benefits of UX and design-focused business practices, there is no substantial consensus across companies regarding the focus and core knowledge of UX, its specific benefits for business, or how UX designers work alongside existing occupations to contribute to the business environment [29, 45].

While UX practices are surging from an industry perspective, with UX jobs commonly cited as an area of rapid job growth [15, 35], UX-focused pedagogy and formal educational programs are lagging. Few UX-specific programs exist at the undergraduate or graduate level [63], and many practitioners are working without any substantial and formal education in UX, particularly with the rise in popularity of certificate programs. Many practitioners have been formally educated in adjacent disciplines such as human-computer-interaction, information science, library science, marketing, psychology, and computer science. As UX programs begin to emerge in the undergraduate space [3, 20, 63], educators are still working to identify the core competencies required in UX as a discipline and occupation in its own right, rather than as a bricolage of other existing disciplinary coursework.

3 RELATED WORK

Bridging the Research-Practice Gap in HCI via Practice-Led Research

HCI researchers have shown continuing concern towards the substantial gap between research and practice, focusing primarily on how practitioners adopt research theories and outputs from academic sources. To understand how theory was used by practitioners who "work in industry and are in the business of researching, designing and evaluating products," Rogers analyzed two surveys, one in the UK and the US, and the other in Denmark [57]. She found that practitioners were interested in using theory, but faced difficulties such as not knowing how to apply the analytic frameworks to specific design situations, and the dilemma between the pressure to solve problems quickly and the desire to grand their work theoretically.

Building upon Rogers' arguments, Stolterman explained that one reason that HCI research has not yet successfully supported design practice is because it is grounded in and guided "by a sufficient understanding and acceptance of the nature of design practice" [60]. Stolterman noted that HCI research should be based on a deep understanding of design *complexity*, due to the focus in design on knowledge that is brought to bear within situated and messy realities. Specifically, Stolterman [60] further argued that complexity in design is different from that in science, because designers have to address unique situations with specific people, situations, desires, needs, time, and resources at hand, consider the actual manifested outcome of evoking emergent qualities, attend to the specific use context and the whole composition of contextual elements, and have its success revealed and assessed in time, in real use, and over time. Therefore, the misapplication of scientific reasoning practices to design situations may lead to results that design practitioners do not necessarily consider relevant.

To address this gap, Goodman et al. [21] proposed to research design practice complexity from a reflective perspective that values the experiential quality of design complexity, the activities of designing, and the contexts of designers' actions. Their six-month study of interaction designers found that although designers did not explicitly sought HCI theories, assessments regularly occurred in their design practice based on their "implicit theories of good design" [21]. Goodman et al. [21] thus stressed the importance of studying design practice, and understanding and theorizing interaction designers' experience of their own work, which they believed would lead to a common intellectual foundation between interaction design and HCI research.

In recent years, an increasing amount of practice-led research has been conducted, investigating many aspects of design practice, such as the designer-tool relationship [61], designers' personal experiences [67], designers' conception of methods [25], and designers' views of context [4]. Joining and building upon this body of research, our study concerns designers' online Q&A activities, documenting UX practitioners' use of Stack Exchange to seek and argue for design knowledge as they address specific design situations.

Studying Online Practice in Design Research

While most studied design practices in previous research have taken place in physically collocated settings [21, 61], information and communication technologies (ICTs) have become indispensable in supporting design practices. Three types of online design practices have been studied with the most frequency: online design studios, online design communities, and design critique facilitated through novel ICTs.

Online design studios, conceived as the online equivalent of traditional, offline design studios, have existed for more than two decades (for a brief history, see [8]). Notably, Maher et al. [52] detailed the characteristics of a "networked design studio" including a design group composed of people from geographically distributed places, computer-mediated and computer-supported design process and designerly communication, digital forms of information "inside" the studio, and digital forms of final design documentation. More recently, researchers have begun to explore a variety of issues related to online design studios such as social networking [59] and participatory design among non-designers [14].

Different from online design studios, online design communities situate design practice in a "wilder" context consisting of potentially numerous participants with much more diverse backgrounds and expertise. Researchers have started to document how online design communities could support the development and maintenance of design competency. For example, online platforms allow UX designers to seek and share a wide range of knowledge [27, 40], use professional

disclosure to connect with fellow designers [42], and collectively identify occupational challenges and envision future developmental paths for their occupation [41]. Online design communities are also viewed as collective and distributed intelligence to generate high-quality design outputs from grassroots designers. Piller et al. [55] described how online customer communities of commercial products (e.g., Adidas, Lego, and American Eagle) enabled collaborative co-design and fostered joint creativity and problem solving in product design. Ahmed and Fuge [2] developed computational models that could effectively rank design ideas submitted within an online design community.

Critique is central to the creation and improvement of design, and enables designers to extend domain knowledge [5] and acquire and employ appropriate design methods [17], guiding the designer's practice. In the last decade, the HCI community has addressed the role of online communities and crowdsourcing platforms in generating quality feedback related to critique [37, 51, 65, 66].

In sum, researchers from diverse disciplines with differing foci have valued online forms of design practices. However, to our best knowledge there are few studies of online UX design practices within the HCI and design literature (see [27, 37] for rare examples). In this paper, we investigate designers' online Q&A contributions as an important aspect of online design practice, thereby contributing to the HCI community's understanding of designers' competency-building activities, building new knowledge about the conceptual pathways that represent the evolution of UX knowledge.

Designerly Ways of Knowing

Design researchers have argued that knowledge in design is different from that in science in terms of its production and dissemination [13, 60], and there are forms of knowledge that are particular to the awareness and ability of a designer [12]. Cross noted that design knowledge has three sources, including people who are naturally designers, the tactics and strategies of designing, and the products' forms, materials, and finishes which embody design attributes [12]. He further argued that design research based on people is a form of *design epistemology*, or the study of *designerly ways of knowing*. Acknowledging that the notion of designerly ways of knowing is ill-defined, Cross listed five aspects: designers tackle 'ill-defined' problems; their mode of problem-solving is 'solution-focused'; their mode of thinking is 'constructive'; they use 'codes' that translate abstract requirements into concrete objects; and they use these codes to both 'read' and 'write' in 'object languages' [54].

In this study, we consider the use of ICTs, and specifically Q&A sites, as a cognitive support for practitioners' performance of designerly ways of knowing; the process of engaging in Q&A conversations commonly addresses instances

where UX designers confront ill-defined problems in their design, and struggle to seek definite answers from established knowledge resources because the design situation is inherently unique and messy. These designers' strategies for engaging in Q&A activities is focused on finding a pragmatically good answer to their design problem. Thus, their mode of argumentation is naturally constructive, yet limited by the sociotechnical affordances of Q&A sites. In collectively formulating an answer, they rely upon codes to translate problems and solutions into the rigid format of online Q&A.

Ways of Bubbling Up UX Knowledge

With the goal of bringing additional focus to online design practices, in this study, we particularly address how a "bubbling up" of UX knowledge from analyzing designers' online practice, might be accomplished by extracting ideas from practice to inform research and theory development [28]. In particular, we use a practice-led framing to document the activities of UX designers, as they interact through distributed communication supported by Stack Exchange.

In the past decade, a few HCI researchers have already put forward efforts [47, 58] to define, scope, or demarcate UX knowledge from the practitioner's perspective, using surveys and interviews to directly solicit information from UX practitioners. Notably, Law et al. [48] conducted a survey of 275 researchers and practitioners from academia and industry to explore respondents' background, their agreement with 23 UX statements (e.g., "Fleeting and more stable aspects of a person's internal state (e.g.. needs, motivations) affect a person's experience of something"), and preference amongst five UX definitions. The survey was extended and replicated by Lallemand et al. [45] among 758 practitioners and researchers from 35 nationalities in 2014. Using interviews with experienced designers and questionnaires among university students, Tokkonen and Saariluoma explored how UX was understood among professionals and novices [31].

In comparison to the aforementioned studies, we adopt a more naturalistic approach in examining conversations that have taken place as an component of everyday design practices, attempting to describe everyday online interactions among a distributed set of UX practitioners from diverse locations and work contexts.

4 METHODS

The Q&A Community Studied

Our study site is the user experience community supported by Stack Exchange[1]. Stack Exchange is a large network of 170 Q&A communities, including Stack Overflow, which focuses on programming and is one of the most widely studied Q&A sites by researchers. The UX community we are studying

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[1]https://ux.stackexchange.com/

belongs to this network, and had its first question asked on September 22th, 2008. On the site's interface, a list of Q&As is at the central place, with functionality for tagging and displaying members' reputation.

Q&A communities differ from general UX communities, like those supported by Reddit or Facebook. This community is focused on specifying UX knowledge that will be archived and remain useful for a wider audience. The community's description reads: "*we're working together to build a library of detailed answers to every question about user experience,*" and suggests that community members should "*avoid questions that are primarily opinion-based, or that are likely to generate discussion rather than answers.*" The community also explicitly encourages integrity and originality of writing questions and answers, as its policies note that "*posting the work of others with no indication that it is not your own is frowned on by our community, and may result in your answer being down-voted or deleted*" and that users should "*always give proper credit to the author and site where you found the text, including a direct link to it.*"

The site includes built-in reputational mechanisms to encourage high-quality questions, answers, and edits of existing questions and answers. Higher reputation gives users more privileges such as the ability to comment and the ability to vote down. Thus, to some extent, we have relied upon the community curation and roles built into the ICT to validate the relevance and quality of the overall corpus.

Data Collection

We used the official Stack Exchange API to collect Q&A communication among UX practitioners from September 2008 to September 2017, including a total of 21,216 questions, 56,486 answers, and 9,936 unique authors who had written at least one question or answer. The dataset was stored in a local MySQL database for analysis. The community experienced rapid growth as measured by the monthly number of posts from 2008 to 2013, and maintained momentum at this active level from 2013 to 2017.

Data Analysis

RQ1: What concepts and knowledge categories characterize this body of UX knowledge? To answer this question, we relied upon the Stanford Log-linear Part-Of-Speech Tagger [62]. The tagger is able to assign parts of speech (e.g., noun, verb, and adjective) to each word in a provided dataset. As a first step, we considered identified nouns as a candidate for a UX concept, informed by psycholinguistic work that found nouns to be more basic than verbs in human language learning [19]. We used the tagger to process all text in our dataset, and generated a set of UX concept candidates, each provided along with their frequencies in our dataset. The

initial candidate list contained 53,281 words, with their frequencies following a long-tailed distribution (max = 90,938, min = 1, avg = 37.5, std = 557.5). The criteria we used to delimit a UX concept was that a word must have an unambiguous meaning that is relevant to UX design. For example, "time" is not a UX concept, because it can be either used as a generic everyday word, or used to refer to the temporal quality of design. "User," on the other hand, has the unambiguous meaning that people who use a designed thing. Two coders, who have experience and expertise in researching and teaching UX, double coded all the candidates. For words that the two coders disagreed over, they went to the actual Q&A communication to check if the word was used with only one meaning. Through this process, we were able to generate a set of 602 UX concepts that we consider a representation of UX knowledge.

We used qualitative content analysis [23] to code all the 602 concepts. The unit of analysis was at the concept level, and the coding was performed in an inductive manner. The same two coders assigned a code to each concept individually. They then discussed and compared their list of codes while moving back and forth between codes and concepts. With a consolidated code list, the two coders engaged in further abstraction, drawing from their collective interpretations of codes. In the end, we generated six primary categories. Each primary category contains one or more secondary categories. It is important to note that qualitative content analysis relies upon coders' interpretations, drawn from their knowledge and experience [23]. It is possible that the same list of concepts could be analyzed differently by other researchers, and to facilitate this, we have deposited our list of concepts for further study [38].

RQ2: How has UX knowledge shared on this site evolved over time? To answer this question, we measured and visualized knowledge change in terms of the percentages of UX concepts in each year from 2008 to 2017. Through this we were able to identify shifting areas of UX knowledge as reified in UX practitioners' language.

5 FINDINGS

Describing a Body of UX Knowledge

Figure 2 depicts the UX vocabulary we identified to characterize UX knowledge within the Q&A community. The vocabulary covers six primary categories: *conceptual*, *specified knowledge branches*, *perceptible features*, *designer-oriented*, *basic technology terms*, and *beyond the cubicle*. Each category contains secondary categories.

The *conceptual* category includes UX concepts that are abstract. It includes two secondary categories: *theory* and *intermediate-level knowledge.* In delineating the line between these two secondary categories, we draw from Höök and

Löwgren's discussion of intermediate-level knowledge [33], which separates design knowledge into three categories: theories, intermediate-level knowledge, and ultimate particulars. Höök and Löwgren characterized intermediate-level knowledge as "more abstracted than particular instances, yet […] not aspir[ing] to the generality of a theory" [33]. Theory and its adoption by practitioners has been frequently discussed in the HCI literature [57, 60] when compared to intermediate-level knowledge; however, intermediate-level knowledge has a practical orientation, existing in forms such as guidelines, criticism, annotated portfolios, and heuristics, and is highly instrumental to practitioners [27, 32, 50]. Therefore, in the *conceptual* category, we found it necessary to distinguish between *theory* and *intermediate-level knowledge*. We categorized the names of celebrity UX thinkers or groups such as the Nielsen Norman Group into *intermediate-level knowledge*, because references to them occurred primarily in situations where practitioners looked for intermediate-level knowledge.

We identified six specified knowledge branches, including *accessibility*, *information architecture*, *privacy/security*, *usability*, *user mental model*, and *visualization*. In each specified knowledge branch, the words we identified all had unique meanings and origins related to the knowledge branch, such as accessibility, vision, and blindness in accessibility.

We did not find any words that had a specific meaning related to UI design or IxD, perhaps because these two disciplines concerned the design of basic, perceptible features, which served the basis for discussing other more specified knowledge branches. Consequently, neither had a unique vocabulary that other knowledge branches did not use. Instead, we identified numerous interface elements and interaction patterns that were basic enough to be used in any UX-related topics such as accessibility, privacy, or usability. With this consideration, we categorized them as *perceptible features* of a design product.

The *designer-oriented* category describes words that were specific enough to refer to specific elements or moments in design activities, such as *design basic* (i.e., basic design terminology), *design process*, *design tool*, or *user research*, but were not pinned to any specific system feature or knowledge branch.

Tech basic refers to basic technology terms that designers must master in their daily designerly communication, but that are not necessarily *design-oriented* terms. For example, practitioners in this community used "page" to refer to the design of a webpage, but page is also a common Internet term.

The category of *beyond the cubicle* refers to a substantial yet messy set of terms. Each of them denotes a specific meaning that is beyond the designer's immediate design work, but yet shapes their work in important ways. For example,

the *commercial* category includes issues that designers must contend with when designing for commercial organizations. The *value* category denotes legal, ethical, or cultural concerns. The *social* category contains all the social roles that UX designers need to cooperate with in an organizational setting.

This categorization strategy at the word level allows us to investigate UX knowledge from a linguistic perspective, which is different from prior work that examined the topics of the questions at the content level [40]. First, at the content level, each question needs to comply with community policies and directly address a UX topic. Therefore, the typology of question topics suggests UX designers' conscious knowledge needs. However, the specific words that people use are casual, nuanced, and oftentimes messy, reflecting the large social and cultural trends.

Second, at the word level, while some words still have strong indications of their primary concerns (e.g., blindness in accessibility), others do not (e.g., icon and button).

Third, the word-level categorization and the construction of UX vocabulary helped us to map out a more comprehensive landscape of UX knowledge. For example, there have been nascent, small-scale discourses about law, culture, and gender in UX design, which are not yet established but have the potential to develop into specified knowledge branches that could demand more attention from UX practitioners.

Fourth, mundane words (e.g., *tech basic*, *design basic*, and *interface elements*) constituted the main building blocks in terms of either the sheer number of words they have or the high frequencies of these words.

Changes of Word Use in UX Vocabulary

In this section, we map out the changes of UX Vocabulary over the nine years represented by our corpus in this Q&A community (see Figure 3). When organizing the charts in Figure 3, we did not strictly follow the six primary categories that we established in the UX vocabulary, but considered the numerical similarities of their percentages. Therefore, we arranged design basic, interface element, interaction pattern, and tech basic into the same chart. The fluctuation in the years of 2008 and 2009 across all the five charts is primarily because the community only appeared in 2008 and had very few Q&As in the first two years. When interpreting changes of word use, we draw from our experiences as UX researchers and educators to consider several possible explanatory factors. First, technological innovations in the past decade could lead to an influx of new technology-related terms. Second, as an interdisciplinary field, UX keeps adopting new ideas from other related practices or disciplines. Third, community development and accumulation of knowledge allow UX designers to explore more specific, nuanced topics.
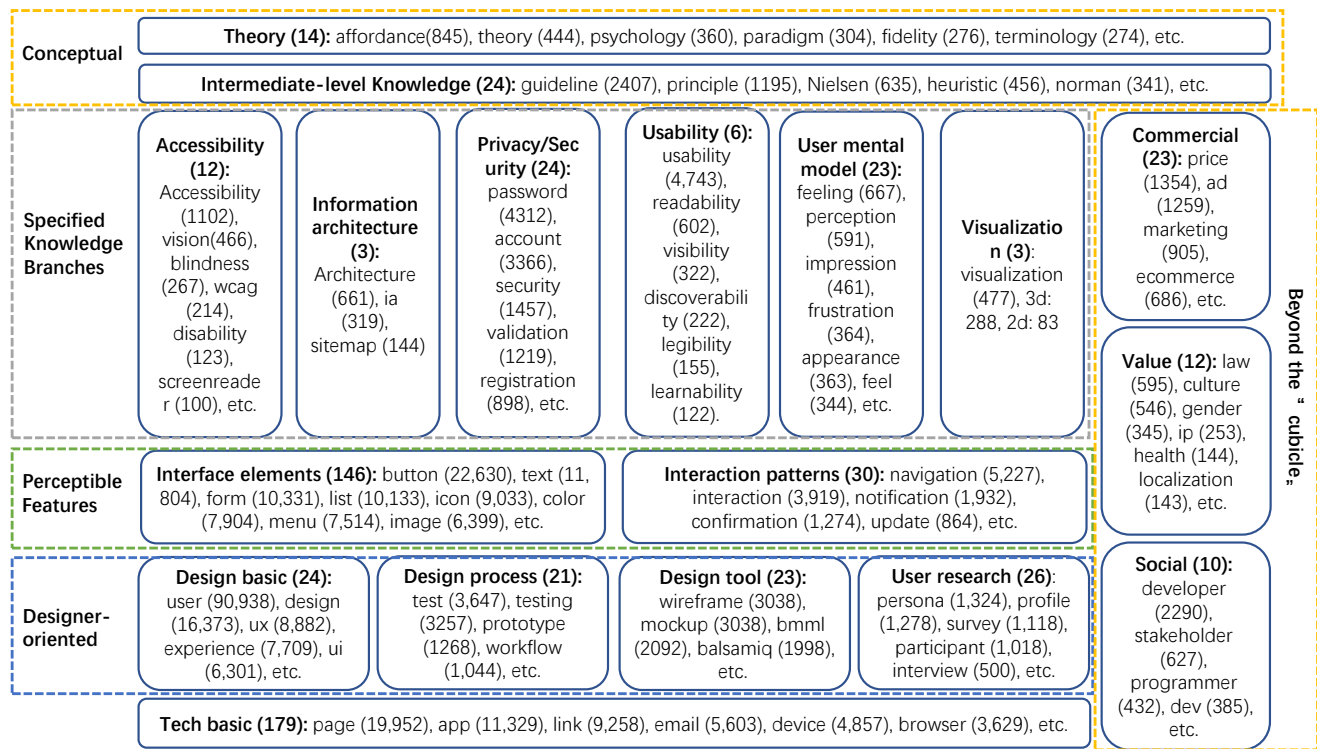
Figure 2: An Emergent UX Vocabulary. Information in each block uses this format: category (no. of terms in this category): term (frequency of this term), …

As Figure 3 shows, in Chart A, basic unambiguous terms in *design basic*, *tech basic*, and *perceptible features* have stably occupied a substantial portion (20%-40%) of UX practitioners' language. This observation should not be surprising, because basic concepts such as "user" and "design" from *design basic* and "page" from *tech basic* served as the basis for any professional conversation about the subject matter of UX design. The usage frequency of *interaction pattern* was strikingly lower than that of *interface element*, because the former is more abstract and its description needs to involve *interface element* terms and possibly other terms. An example is "What icon could be used to mean 'notifications'?" We used a least squares linear regression analysis with year as independent variable and frequency as dependent variable to analyze trends in the usage frequency of all the categories. We found that although *interaction pattern* was relatively low, it had grown steadily over the nine years ($slope = 0.028, R^2 = 0.7286, p = 0.001$). Meanwhile *tech basic* had experienced a steady decline from 2011 to 2017 ($slope = -0.0095, R^2 = 0.944, p = 0.0002$). This suggests that designers relied on less and less general technology terms to exchange design ideas.

In Chart B, *designer-oriented* terms were generally stable, but *user research* experienced a slight increase from 2011 to 2017 ($slope = 0.0005, R^2 = 0.6773, p = 0.0142$). The slight increase was possibly due to the gradually formed consensus that user research must be valued in UX design. For example, a designer asked "Can UX without research really be called UX?" and the top-voted answer explained why user research matters, ending with the claim that "So if you're not doing user research, you're not producing the best UX that you can. Which in the current climate is a dumb, dumb move."

Within the six specified knowledge branches shown in Chart C, *visualization* and *information architecture* (< 0.3%) were much lower than the other four (nearly 1%), suggesting that the former two topics were more distant from UX practitioners' primary concerns. *Privacy and security* words have been used more often through these years ($slope = 0.0296, R^2 = 0.5983, p = 0.005$).

In Chart D, usage of *theory* and *intermediate-level knowledge* words remained stable and low (< 2%) over the years, reflecting the persistence of the research-practice gap.

Chart E shows that from 2008 to 2017, *commercial* ($slope = 0.0101, R^2 = 0.678, p = 0.002$) kept attracting more attention. *Value* was in a similar situation ($slope = 0.005, R^2 = 0.5668, p = 0.0072$). These two trends could imply that UX designers had increased their emphasis on how their design could translate to financial success, and how their design
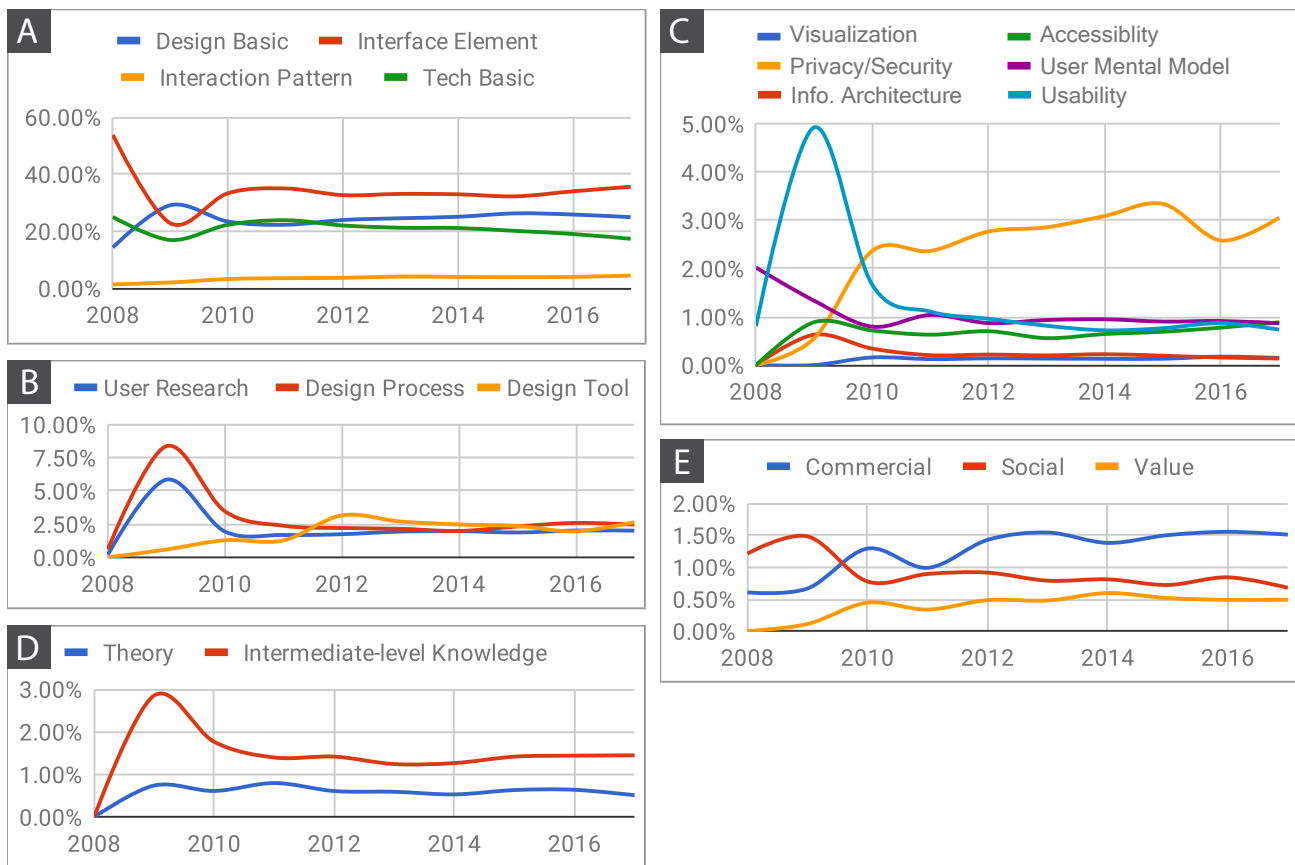
Figure 3: Changes in use of UX concepts from 2008 to 2017 by percent of all Q&As. Charts A–E are organized by greatest to least relative percentage of occurrence.

could incorporate more social, political, and cultural considerations.

Considering these characteristics of the conceptual trajectories of the vocabulary, we suggest that these changes resonate well with many trending ideas in the industry, such as the increasing concern over *privacy and security*, more attention to design for profitability and values, and possibly more emphasis on interaction scenarios. The decrease of *tech basic* terms, and increase of *user research* terms together suggest that, as the UX vocabulary is becoming more specified, UX practitioners are converging on a more specified body of knowledge. These are important changes worthy of further investigation in future research.

6 DISCUSSION

In this paper, we used a mixed-methods approach to describe UX knowledge as it was shared, debated, and articulated by UX practitioners in the UX Stack Exchange community. We were able to identify a UX vocabulary that practitioners

relied upon to communicate knowledge. We also observed the evolution of UX knowledge and conceptual vocabulary over a nine-year period, describing the shifting landscape of UX knowledge as it has been shaped by corporate interest, practitioner concerns, and technological change. Since this study is about a particular UX online community with unique socio-technical features such as Q&A and voting, we do not claim that our findings could be readily generalized to the much wider population of UX designers across various social, cultural, and professional contexts. The purpose of this study is not to provide a definitive analysis of UX knowledge or make a summative assessment of what UX practice as a whole should contain. Our goal is to provide a useful and generative account that will stimulate further research and analysis, and offer up our conceptual typology as a starting point from which we as HCI and UX researchers explore methodologies as to whether and how we could aggregate and consolidate heterogeneous knowledge resources such

as practitioners' experiences and opinions, offline and on-line, and academic output, in order to move towards a more coherent and robust body of UX knowledge.

Next, we situate the contributions of our work across multiple research strands, including design practice research, defining and demarcating UX, and UX pedagogy.

Towards Defining and Demarcating UX

In contrast to prior work that solicits opinions from UX prac-titioners with predefined questions [31, 45, 48], our study cap-tured designer interactions in a more natural setting where conversations that support everyday design practices took place. As such, we were able to capture a common vocabulary that UX practitioners in this community used to describe a wide range of UX-related topics. At the Q&A level, our prior work [40] identified a typology of knowledge that UX practitioners invoked. At the word level, this study located a messier but more comprehensive set of words that have become established over the development of UX practice.

In this paper, our most substantial contribution is in de-scribing a promising approach to identifying a shared de-scription of naturalistic UX designer practices, adding to the practice-led research literature and further deepening the inquiry of UX practice *on its own terms*. This work builds on prior survey research, using qualitative and computational methods to document what terminology is being used by practitioners, and what conceptual organizations these terms may point towards. In this way, our study operated at a more concrete level in a bottom-up fashion, first identifying un-ambiguous terms, and then connecting these terms to the larger knowledge area they belonged to. In contrast, Law et al.'s survey [48] asked for practitioners' agreements with 23 statements that concern mostly conceptual understanding of UX and require thinking and reflection to answer, such as the statement that "Prior exposure to an artefact shapes subsequent UX." While both approaches to documenting the nature and boundaries of UX practice are beneficial, the present study facilitates collection and analysis of many more interlocutors over a larger span of time and geographic lo-cation, potentially allowing greater coverage of the holistic and evolving worldwide UX conversation.

However, it is important to note that any classification system—particularly computational systems that are not sen-sitive to immediate context and community conversational norms—risks marginalizing or rendering invisible ideas that are less common [7], and that a "modern designerly-oriented understanding of design practice" is a unique human activity different from the scientific approach and is "solidly based in design practice and in the situated and the concrete" [60]. Our own coding process involved many lengthy discussions between the two coders over how to interpret a particular

term. Therefore, we must be careful regarding making scien-tific, methodological claims regarding developing knowledge about design disciplines such as UX. Future work would ide-ally bridge these large scale computational analyses with deep qualitative analysis of community discussions and con-versations with UX practitioners. This triangulation not only has the potential to increase the precision of the UX vocabu-lary and its conceptual evolution over time, but also may aid in strengthening ties between the research and practice com-munities by disambiguating and linking relevant vocabulary and concepts across the research-practice divide.

We also highlight the temporality of UX knowledge that is reflected in the temporal changes of the UX vocabulary. De-sign practice is by nature non-universal and dynamic [60]. It combines designers' own expertise as well as influence from external environments such as trending thoughts and cul-tural logics. As such, the UX vocabulary is bound to change over time, as new disciplinary alliances take hold and others atrophy or change in character. The method we have used to analyze these data over time allows unique insights into this evolution, allowing researchers to track conceptual trajecto-ries as they respond to technological, social, and disciplinary change.

Implications for HCI and UX Education

HCI and UX education has received sustained attention from the HCI and design communities. Researchers and educators the recognize inter-, trans-, and multi-disciplinary nature of HCI and UX, and have called for innovative pedagogi-cal methods to create better-equipped designers that can address the challenges of practice [1, 34, 43, 63]. Even as some studies have shown the barriers to building compe-tency "on the ground," (e.g., [24, 29]), there is still relatively little knowledge of how to effectively prepare students for the challenges of a rapidly evolving profession. In light of the long-recognized research-practice gap, an question for educators remains: *How do we best prepare students in terms of knowledge acquisition and competence development?*

This paper makes contributions to nascent UX pedagogy by providing a UX vocabulary that is informative to both cur-riculum design and students' self-learning practices. We have published the generated UX vocabulary [38] as a contribution to the generation of UX curricula, guiding efforts towards a dynamic HCI curriculum already underway within the CHI community [10]. When designing UX curricula, UX educa-tors may consider this vocabulary as one valuable resource while evaluating topical coverage, comprehensiveness of of-fered courses, and overall program currency. For UX students, the vocabulary may be useful in checking whether they are familiar with dominant terms, concepts, and tools, as well as increasing their awareness of the shifting landscape of the UX industry and their need for ongoing self-learning.

While the vocabulary is by no means finite and conclusive, it represents a starting point to employ social computing analysis to enrich UX education, and invites more discussion among HCI and UX educators on how social computing knowledge might be more systematically accumulated and analyzed to inform future means of academic and professional preparation, encompassing both formal education and lifelong learning. Thus, these concerns bridge across design-related concerns of the HCI community, social computing interests of the CSCW community, and learning-focused concerns of the CSCL community.

Implications for Design Research

Joining the literature on design practice and practice-led research [21, 61], this paper described a specific online form of design practice from the lens of design knowledge. Online Q&A interaction has many similarities with knowledge transfer between designers in offline design settings such as a studio or workplace. However, online Q&A interaction is also deeply shaped by the socio-technical characteristics of Stack Exchange. Different from offline, face-to-face Q&A practices in a classroom or a studio which commonly take place between just two people, online Q&As represent a collaborative and dynamic community where a large number of members can edit or upvote both questions and answers, with the shared community goal of building "a library of detailed answers." Thus, there is a collaborative and archival quality to these online interactions that distinguishes these practices from face-to-face knowledge transfer practices.

Given the existence of the research-practice gap and the fuzzy and evolving nature of UX knowledge, online design practices such as Q&A provide an important way for both UX practitioners to maintain their design competency. Specifically, this Q&A community appears to provide UX practitioners with a mechanism to discover and consolidate designerly ways of thinking and problem solving through numerous design scenarios described in the questions, and design suggestions laid out in the answers.

Online design practices are often archived and searchable, allowing design research investigation from various aspects such as self-learning and critique. Given the prevalence of ICTs, design researchers cannot afford to ignore online design practices and their role in the development and maintenance of design competence. Specifically, the method we used to identify design knowledge in online design practices has important implications for design research. We have not claimed that we have identified, for all time, the disciplinary boundaries of UX knowledge. Rather, we acknowledge the ongoing situational and societal complexity of design practice [60] and thus represent design knowledge as situated and dynamic. Thus, in this paper, we make an effort towards representing a general picture of UX knowledge conditioned by

a specific historical and technological period in a particular online community.

Given the intimate nature of design knowledge in the practice community [56], our approach is potentially useful for design researchers to identify disciplinary knowledge in specific design domains. Gray et al. [28] discussed two crucial pathways associated with researchers' efforts to bubble up practitioners' design methods: first, researchers engage design practice as a form of knowledge generation or inquiry, valuing knowledge about practice on its own terms; and second, researchers recognize that designers use a wide range of ready-at-hand methods to construct design practice and experience. While this paper is focused upon extracting a UX vocabulary, we also believe that the identification of design methods may be possible through this approach. For example, the secondary categories of design process, design tool, and user research, is already oriented towards UX design methods. The identification of a UX vocabulary may form a productive basis for further bubbling-up efforts with different foci.

Limitations and Future Work

The approach undertaken in this study was among the first efforts to articulate UX knowledge through a corpus of online designerly communication. As such, we have identified promising results while leaving more questions to be answered and more components to be refined and improved. For example, we could utilize more metadata such as differentiating question and answer to generate more fine-grained analysis. A detailed comparison can be performed between the knowledge types we identified and HCI knowledge and theory based on a thorough literature review to explicate the knowledge dimension of the research-practice gap. In addition, these knowledge types and conceptual trajectories might be productively compared to "motor themes" already identified in the formal HCI literature (e.g., [49]). Interrelationships between UX concepts may also be identified and utilized to discover semantic relationships and construct networks of UX knowledge in future work.

In this study, we have only utilized the occurrences of a single noun word to construct the UX vocabulary as a first step towards representing and articulating UX knowledge. In future work, we will extend our consideration to other content words such as verbs and adjectives and the relationships among these parts of speech, including UX concepts that appear as a sequence of two or more words (e.g., "information architecture").

This study is focused on a particular UX online community with unique socio-technical characteristics, such as Q&A as its form of communication, the presence of a voting mechanism, and the shared community goal of archiving and consolidating UX knowledge. These characteristics are also

situated in a US-based website with English as a main language of communication. Therefore, our specific findings may not be easily generalized to other online communities or other cultural contexts. In fact, our prior work comparing linguistic patterns between this community and a subreddit UX community revealed remarkable distinctions in the way designers communicated knowledge [39]. Therefore, direct adoption of our findings should be conducted with caution. Future work should include the collection of data from additional and varied online platforms such as Facebook, Twitter, and Medium.com, as well as diverse academic sources such as conference proceedings, textbooks, and industry-focused books.

7 CONCLUSION

In this paper, we performed a mixed-methods analysis of UX practitioner conversations on Stack Exchange, using a combination of content analysis and natural language processing to build a preliminary vocabulary of UX knowledge. Our analysis revealed a diverse array of knowledge types and concepts that emerged from a complex set of disciplinary sources, and a promising set of methods that could be used to further probe the dynamic nature of design knowledge in online communities. The approach to bubbling up UX knowledge is inherently generative in opening up new spaces for both methodological discussions and practical applications in education and pedagogy. Along this direction, we are able to ask broader questions such as how qualitative data analysis might productively be used alongside big data techniques, and how sources of big data such as social media conversations might be effectively utilized to guide future educational innovation.

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