Reflecting on the Impact of HCI Frameworks

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Abstract

Frameworks aim to tie seemingly disparate topics to help researchers identify open areas of research, to assist them in explaining and contextualizing their own work, to generate innovative ideas and designs. While there is a correlation between the number of framework papers and the number of published HCI articles, we found very few authors reflecting on the impact of theoretical contributions, evaluating its use. In this position paper, we argue for the importance of evaluating frameworks in human computer interaction.

Author Keywords

Human-computer interaction; framework; evaluation; theory; reality-based interactions.

Introduction

Frameworks are the foundation of strong research, tying together seemingly disparate topics, showing a complete picture of a research subfield, helping researchers to identify open areas for generating new research and design ideas, assisting to explain and contextualize their results.

Within the field of HCI, there are hundreds of frameworks, from direct manipulation [12] to tangible interaction [3], instrumental interaction [1], co-adaptation [7] or reality-based interactions [4]. We
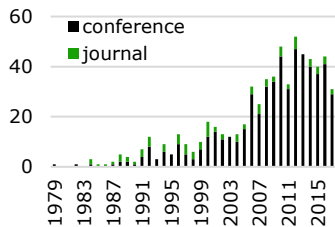
Figure 1. Conference and journal publications in the ACM Digital Library including the word *framework* in the title, and *HCI* as a keyword, organized by year.

note almost 650 articles in the ACM Digital Library that include the word *framework* in the title combined with the keyword *HCI* (Figure 1). We observe a steep increase of articles focusing on frameworks in the last 10 years, with over 400 articles. We should note that this trend corresponds to the emergence of novel interaction styles that diverge from existing paradigms, as well as to general increase in HCI publications, with frameworks representing ~1.4% all papers since 2000.

While new frameworks typically reflect on ones that came before, expanding them [5] or comparing them [9], few researchers take the time to reflect on the impact of a framework, on the role it might have had in shaping a field. Doing so can identify whether and how a framework is used [2] and the way it has evolved since it was created [13]. This position paper identifies the need to investigate and understand the impact of a framework, then summarizes and proposes various methodologies to evaluate such impact.

The Role of Frameworks in HCI Research

As theoretical contributions, frameworks are meant to "inform what we do, why we do it, and what we expect from it" [14]. Rogers [11] defines a framework as "a set of interrelated concepts and/or a set of specific questions that is intended to inform a particular domain area." Frameworks outline the basic structure of concepts, systems, with descriptive or predictive power.

In looking within the subfield of tangible interaction, Mazalek and van den Hoven [9] mapped frameworks by facets (technologies, interactions, physicality, domains and experiences) and by type (abstracting, designing and building). The types of frameworks are particularly interesting, as they reflect the intent of the framework

authors for the impact of their work. Abstracting frameworks focus on categorizing and analyzing past systems; Designing frameworks helps designers and researchers to conceptualize concepts by "outlining problem spaces"; Building frameworks help implement new systems. The authors noted a focus of past frameworks on conceptual designs of systems, with little done in the abstraction category, and almost none meant to help build systems. Overall, frameworks "help us look back at and categorize past tangible interaction system, and look forward at the possibilities and opportunities for developing new systems" [9].

Prior Work Evaluating the Impact of Theories and Frameworks

While theoretical contributions are validated through empirical work [14], few researchers have aggregated these validations onto larger evaluations of the original contributions of frameworks to a field of research.

Clemmensen, Kaptelinin and Nardi [2] investigated the use of activity theory in HCI over a 25-year period. By looking at 109 English peer-reviewed journal or conference papers that used activity theory in some way (beyond simply citing it), they identified five main ways papers related to activity theory: they used it; they referenced a classic text; they identified the specific concept used; they used it alone or in combination with other theories, they comment and reflect on their use. Following, the authors came up with five purposes for using activity theory: 1) as an object of analysis, 2) as a meta tool, to inform the design of additional tools; 3) as a tool for conceptual analysis; 4) as a tool for empirical analysis and 5) as a framework for design. The investigation yielded an overview of the use and adoption of activity theory in

HCI: two thirds used it for analysis, 15% to inform new tools, and the rest (16%) to inform their design.

Velt, Benford and Reeves [13] performed a similar exercise with Trajectories Conceptual Framework, undertaking an analytic literature review of works citing three original academic sources for the framework. They selected a set of 60 papers engaged with the framework. They looked at the purpose the framework served in the citing paper and which concepts were applied. Classifications include situating the work, analyzing and describing an experience, designing experiences, and discussing and building concepts. The paper provides examples to paint a picture of the use of the framework by contemporary works.

Reflections can also help to get a higher-level view on debates within a community. Following a decade of discussion sparked by their 2004 paper, Kjeldskov and Skov [6] performed a meta-analysis of discussions on lab and field evaluation in the mobile HCI research field. By looking at the 142 papers that cited their original publication, they found about 44% that used lab or field evaluations, 11% that compared lab and field evaluation and 45% that engaged in a discussion of field and lab evaluations. Their overall discussion of their findings included a status update of the state of mobile HCI evaluation research.

Conferences have also looked at their impact over time, such as OzCHI, HRI, IndiaHCI, BritishHCI, Brazilian HCI Conference [10]. This helps evaluate trends, directions of research focus, for instance by looking at paper keywords. OzCHI used the exercise to note growing importance of the themes of Design, Health and Well-being and Education at the conference.

While not reflecting on a specific work, it is worth noting Marshall et al.'s [8] evaluation of citations types by CHI 2016 authors. They categorized over 3000 citations as cursory, descriptive or analyzing/critiquing the original work. They found that the majority of papers contained one or no citations that was analyzing or critiquing the previous work. Overall, less than 5% of the citations were critiques or analyses of previous work. The authors note that this is a failure of our discipline, as the lack of critical analysis may lead to poor-quality research.

Guidelines to Evaluating Framework Impact

We argue the importance of evaluating the impact of theoretical research in HCI and propose guidelines to investigate them.

When: Evaluating the impact of a published work in the community requires the dissemination and adoption of the work. Due to the time it takes to discover and assimilate a new research work, combined with the general length of projects and typical HCI publication cycles, we suggest that reflections should take place at the earliest five years from the framework publication date. Reflections after a longer period may reveal a trend as to the type of integration of the material.

How: A citation list provides a starting point to evaluate the impact of a paper, based on the premise that a citation indicates that the citing author was influenced by the cited author. We recommend using a content-based citation analysis to push the traditional citation analysis (basic frequency of citations) further by taking into account the content and the context of citations [15]. Citations can be looked at syntactic level, by identifying their location in the cited work. We

can also look at the semantic level of citations, by analyzing citations based on their intended meaning, by characterizing their contribution to the cited work [e.g. ,8,13], to understand whether they are simply citing to support a fact, or actually use the framework in their analysis, to generate ideas, or even criticize the framework. Contrary to Clemmensen et al. [2] or Velt et al. [13], the analysis should also consider the impact the work may have had as a whole on the community by analyzing articles that may only cite the framework in a cursory manner, or supporting a simple fact.

The impact should qualify the use of the framework by the original authors, indicating if it has been adopted largely by others [e.g. ,13]. The overall impact may be diminished if the work is mainly cited by its creators.

Researchers should also investigate the impact of theoretical work on training future researchers and practitioners in the field: whether and how the work is used in the classroom, to teach concepts, or to generate conversations in the community through workshop or studio proposals, or to invite new work through special issue themes.

Overall, reflections are a good occasion to step back, to identify gaps and propose extensions for the framework. This is an opportunity to reflect on the design and use of frameworks and their impact on the community. We encourage all researchers, whether they have authored framework papers or not, to engage in this type of reflective research.

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