Bridging broadening theory and practical application – the three Ds: deploy, detail, depth.

Human–computer interaction has changed. Nearly thirty years ago, when I co-authored one of the early textbooks on human–computer interaction, the topics we covered ranged from basic human cognition to user-interface software architecture and social and organisational issues. This year, co-authors and I have completed a book on physicality in digital design, which I would regard as broadly part of HCI given much of everyday computation is embodied in devices and smart environments. However, its theoretical scope has had to expand further including old topics such as classic perceptual and cognitive psychology, but also elements of architecture, human geography, and historical linguistics, as well as additional aspects of computing, from fundamentals to embedded electronics.

Against this backdrop of broadening theoretical roots, universities across the world face demands to 'deliver' computing graduates that are more 'industry ready', reflecting vocational patterns of other professional disciplines such as medicine, law and engineering. HCI education within computing curricula often addresses this by teaching design-centred courses focused particularly on UX issues. These complement students' other skills and we hope expand students' conceptions and personal skills, but may be ignored as irrelevant by some or simply disconnected from other studies.

Interestingly this last attitude contrasts with industry where for every UX professional there are perhaps ten front-end developers, who are universally eager to understand both deep UI issues and appropriate architectural frameworks.

Within industry, the role of the HCI practitioner is also changing. From the times of the lone 'usability tester' – far too late in the development process, most software development companies now realise they need one or more dedicated UX specialists, even if their work may sometimes appear to be focused on pixel-perfect graphics whilst the broader understanding of the user journey belongs with the product manager or marketing. For very large companies this dynamic is developing as big-data analysis and A–B testing replace the detailed decisions of UI design, leaving the UX team to focus on broader issues – precisely the job many small-company UX experts do not address.

To some extent these changes speak to the broad CS curriculum: I have used live UI coding in class, there is growing use of video material, and a small number of courses adopt radically project-focused pedagogy complimented with just-in-time learning. Online professional development and OER, notably Interaction Design Foundation, complement these academic approaches. I have become a proponent of a ***3Ds framework*** for computing, which inverts the traditional order of delivery and naturally integrates HCI: ***deploy*** first (make something that works), then ***detail*** (look under the hood), and finally ***depth*** (understand theoretical roots). This brings human issues to the forefront, but as a natural outcome of a holistic view of computing. At my own university a new

masters+PhD doctoral training programme for AI and big-data is taking a 'people first' approach driving human-centred application concerns into deep questions for core computational research.

Maybe we need to reimagine HCI education to be both more connected with code and development and more embedded in theoretical underpinnings.

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