CROSS-TRAINING IN DESIGN AND HUMAN FACTORS

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The education of future human factors professionals is a critically important topic and a concern for the professional associations of human factors/ergonomics professionals. The Human Factors and Ergonomics Society (HFES) has a long history of involvement in the career development of its members and the Education Technical Group has encouraged presentations and panels on career development topics at the Society's annual meetings. This panel will continue this tradition and is intended to stimulate and sustain a discourse between the human factors and design communities both in the industry and academia, as well as serve as an exemplar of industry-academia interaction.

INTRODUCTION

Over the past several years periodic surveys of new human factors/ergonomics (HF/E) professionals' experiences in their first workplace post-graduation as well as similar surveys of the employers' knowledge and skills expectations for new HF/E professionals have revealed remarkably consistent trends, calling into question the quality of education in human factors-related academic programs (Rantanen & Moroney, 2011, 2012; Rantanen, 2016). A common trend in all these surveys was lack of design skills.

In the 2011 survey of new human factors professionals, design skills were most common on the list of skills they wish they had learned before they started working (Rantanen & Moroney, 2011). In the 2012 survey employers complained that new professionals who have graduated from current HF/E programs have little experience in applying their knowledge to the actual design of user interfaces, lack understanding of the design process in organizations, and lack of creativity in evaluation of product concepts and interfaces with users (Rantanen & Moroney, 2012). These trends persisted also in the 2016 survey, where 21% of respondents called for better design skills. Specific issues ranged from design of specific products to understanding of design constraints such as time and cost (Rantanen, 2016).

The success of a product depends on the collaboration of many different disciplines, not the least of which is Industrial Design (ID) and HF/E. The designer's job is often to innovate: He or she must embody new features and inspire desirability while promoting brand language and maintaining trade dress. Yet, all the innovation is meaningless if it is not usable. To this end, fluency in human factors is a critical component of success.

In the realm of product development, human factors engineers are responsible for championing the viewpoint of the intended user(s) through the process. It is on the HF/E professional to ensure that the needs of the user are identified, understood, and met through the design. HF/E professionals are uniquely positioned to do so as they rely on several different skill sets at different points in time to be able to achieve this.

Current HF/E curricula provide much information about user-centered design, but arguably insufficient training in the design process. Problems arise when a human factors engineer is tasked with communicating with designers and engineers the requirements of design from the user perspective. HF/E professionals who advocate for design changes at inappropriate points in the design cycle are putting their credibility with other design professionals at risk. Understanding how products are developed, in general, will enable them to advise and communicate better to their design counterparts. Integration of HF/E curricula with other academic units that teach development process is therefore warranted.

Augmenting the education of human factors professionals is only half of the story, however. Designers trained in various design schools and programs should also know more about HF/E methods and data to be better able access relevant standards and design guidelines, and indeed to better interface with HF/E professionals in the design process. HF/E plays a much larger role in the design process than the introduction to ergonomics taught in many design programs might indicate. Leveraging HF/E expertise to define user needs and understand workflows through lenses of perception, cognition, and action can influence the design process as early as in the identification of opportunities and go on to structure early ideation. HF/E professionals are invaluable when it comes to providing feedback on design concepts, but design professionals should be able to create sound concepts from the beginning. Designers should be equipped to speak the language of HF/E and create designs that reflect usability standards from the start, and in turn, the breadth and depth of HF/E training should reflect the professional demands in the workplace.

PURPOSE OF THE PANEL

This panel was intended to help bridge a current disconnect between human factors engineers and designers, who work together in the industry but have very different training backgrounds. To this end, our panel had a deliberate 2 × 2 design: Two of our panelists are professionals working in the industry, a human factors engineer and an industrial designer, and two are educators, a professor of ID and a professor of Engineering Psychology. This design allowed for rigorous examination of the issues from the four main perspectives.

PANELISTS

Alisa Rantanen

Alisa Rantanen is a senior designer at Insight Product Development in Chicago, with much experience in research and strategy. In the past 5 years at Insight, she has worked in the medical device sector to imbue physical and digital design solutions with qualities informed by insights gathered directly from end users. Alisa holds a BFA in ID from the University of Notre Dame.

Michael Lau

Michael Lau is the Director of Human Factors at Insight Product Development in Chicago. The medical device development space is faced with numerous challenges and complicated by a regulatory environment aimed at promoting safe and effective products for use. Michael has a BS in Kinesiology with a specialization in Ergonomics from the University of Waterloo and MS and PhD degrees from the University of Michigan.

Esa Rantanen

Esa Rantanen is an associate professor of psychology at the Rochester Institute of Technology (RIT), teaching courses and advising graduate students in the MS program in Experimental Psychology with an Engineering Psychology track. He has BS and MS degrees from Embry-Riddle Aeronautical University. He also has an MS degree in Industrial Engineering from the Pennsylvania State University, with specialization in HF/E engineering, and a PhD degree in Engineering Psychology, also from Penn State.

Stan Rickel

Stan Rickel is an associate professor of design at RIT. After graduating from Pratt Institute with his BID, he was appointed as senior designer for Charles Pollock International, and went on to establish his own firm, Rickel Jackson Design. He also has MID from Syracuse University. Stan taught at Pratt Institute and Syracuse University prior to joining RIT's ID program in 2001. At RIT he served as the Department Chair and the Graduate Director.

DISCUSSION

We structured our discussion in a challenge—response format. Each panelist challenged the others from his or her particular position, and we all responded to the challenges from our respective positions. The initial challenges and responses are presented below.

Challenges to the Human Factors Professor

Michael Lau: What are the challenges in academia that prevent HF programs from having a standardized list of courses that all graduates from all HF programs could be expected to have taken? How do you get design faculty to teach HF students?

Esa Rantanen responds: There are very few undergraduate HF/E programs, which means that only few HF/E courses are offered as part of BS programs, traditionally in psychology or engineering. Graduate programs tend to be relatively light on course requirements with emphasis on thesis research. As such, HF/E courses are typically tailored to fit within the "host" programs with little room for standardization. Efforts to have design faculty participate in instruction of HF/E course are hampered by scheduling constraints and the overall workload of instructional faculty in academia.

Stan Rickel: Within the university setting how would you introduce HF/E to various programs and curricula? What are the barriers, both real and implied? In a specific or conceptual manner, how would you envision a HF learning "space"?

Esa Rantanen responds: Despite recent interest in interdisciplinarity in college curricula, programs and departments offering them are still quite insular and constrained by rigid administrative structures. Therefore, it is difficult to insert interdisciplinary content into established curricula. Experiential, or project-based, learning might offer novel opportunities to provide interdisciplinary instruction and experiences to students, but the administrative environments lag behind such teaching and learning innovations, hampering their implementation.

Alisa Rantanen: What role should design play in a HF curriculum (i.e., what value does it add to academic work)? What barriers have you encountered to successfully teaching design skills to HF students?

Esa Rantanen responds: Design is an integral part of the HF/E discipline, or rather, design is the purpose and goal of HF/E. Therefore, I argue that HF/E researchers and practitioners will be better in their métier the better they understand the goal of their efforts. We may also view the designer as the end user of the HF/E professionals' work. Designers will apply the HF/E research results and design guidelines and the more user-friendly they are the more readily they get applied. By understanding the needs of the users of research results, heeding the credo of HF/E, "Know Thy User", HF/E professionals can ensure maximum impact for their work.

The barriers exist mostly in the HF/E curricula in universities, where few professors in the discipline have sufficient insights into the design practice to share with their students. There is a distinction between teaching design principles derived from research (conceptually) and teaching design (i.e., the use of such principles).

Challenges to the Human Factors Engineer

Esa Rantanen: Reflecting on your career since receiving your doctorate, what is it that you wish you had learned during your graduate training but did not? How could HF/E graduate programs better prepare students for careers in the industry?

Michael Lau responds: ID, and design at a more abstract level, was never a priority in my human factors education. Achieving good design was an implicit outcome, but it appeared that most of my professors did not know what exactly that meant and/or how to achieve it. In HF/E studies, the focus was on user-centered design and how to design for humans or to elicit user feedback during the design process. There was no discussion about the profession of design and how HF/E interfaced with that. Interestingly, there were courses offered in other engineering departments in my graduate studies that were focused on product design and development, but I did not know to actively seek out such electives. In hindsight, I wish I had more instruction about design, design process, an introduction to the way designers might approach developing a design solution, and more education about the way things are made—a general understanding of prototyping and manufacturing.

HF/E programs currently do not appear to have a great understanding of what exactly HF/E professionals actually do in industry. Not knowing what skill sets are needed to succeed is not an excuse. Many HF/E programs are a product of the specific expertise of the faculty that run the programs. Thus, there is no basic core curriculum that is standard across all programs.

I benefited from a highly interdisciplinary undergraduate program, which sent us to other departments to learn the fundamentals of the various subjects that would serve as the foundation for advanced HF/E coursework. I argue that this is a necessary part of any HF/E education. Science, math, social science, economics, statistics, and applied human sciences give an HF/E professional the confidence to say that they understand humans at a base level. Graduate programs need to do a better job of identifying the gaps that a student might have from their undergraduate degree and fill them with pre-requisites prior to the student being enrolled in the program.

Alisa Rantanen: What frustrations have you encountered when collaborating with the design team? What might they be attributed to, and how might they be addressed?

Michael Lau responds: Potential frustrations come in the form of designers who do not understand the role of the HF/E professional early in the design process, identifying and scoping out the usability challenges that are present for what is being designed. HF/E can be used to help guide design (without doing the design itself) because of their systems-focused thinking: that the design itself does not exist in isolation, but within a larger context. Awareness of what HF/E can bring to the table and to make sure that it is actively included will begin to address gaps that exist. These start at the education level.

Stan Rickel: As a HF/E specialist, what knowledge base and application of HF/E would you like to see taught to designers? In the "ideal" world what would interaction/intersection of HF/E and ID look like?

Michael Lau responds: Not all designers will have access to HF/E expertise, so I think it is important to have the fundamentals of user-centered design taught to designers. I would also love for designers to know that there is a difference between design research and human factors/usability and not confuse the two. It would be valuable for designers to have a sense of how much information about humans is actually available and how to tap into that through the use of HF/E professionals. In the same way that designers understand that they need to rely on traditional engineering disciplines to bring a design to life, they could learn to rely on HF/E to build the appropriate use experience.

Designers should have a basic understanding of biomechanics for basic human actions (e.g. gripping and other hand actions, pushing, pulling, walking, running, lifting) so that they can think through what the physical implications are for a design they are making. They should also have a solid understanding of how to create an affordance in a design and be able to understand at a nuanced level how the affordance changes by changing any dimension being designed.

Ultimately, the fields are so vast and with so many different areas of expertise within them that it would be difficult to create a single profession out of the two. We would want to keep them separate and in a state of ten-

sion for the health of the design. I think designers should be given the license to explore and be creative so that the boundaries are pushed by the design. In this same way, HF/E professionals should review and assess the usability of the design objectively and independently.

Challenges to the Industrial Design Professor

Esa Rantanen: How do you prepare your students to interface with the HF/E professionals and engineers they would likely work with in their jobs as industrial designers? Specifically, how do you teach students the language HF/E people and engineers speak, (quantitative) data, in terms of evidence for design?

Stan Rickel responds: Ideally, ID prepares their students to interface with a variety of professions. ID specialists are generalists. At RIT we have created a few opportunities where multiple disciplines interact and engage in the development of a product of concepts. Ideally this "interface" would be a common thread throughout students' academic career, but unfortunately, these experiences lean towards the exception rather than the rule. ID students tend to readily extrapolate from primary studies but do not generally adhere to thoroughness of additional studies. One of the challenges with all of our students is learning to understand that opinions are not facts. This underlines the need to understand the methodologies used to gather, analyze, and interpret data.

We teach the "language" in a variety of ways. First would be understanding the engineering criteria and how it is presented specifically to the ID field. In our human factors class, the faculty present the information as well as its application. Most of the details and concepts are from text (Sanders & McCormick, 1987) while the applied part of the class tends to be anthropometric using the classic graphics of Dreyfuss (1960), function/task analysis, or various standards. Critiques (design analysis) is a very common practice, but not always methodical, nor procedurally documented.

Alisa Rantanen: What role should HF/E play in an ID curriculum (i.e., what value does it add to academic work)? What barriers, if any, have you encountered to successfully teaching HF principles to design students?

Stan Rickel responds: HF/E plays a critical role in the design curriculum and understanding of method/process and objectives. Mindfully adapting this to product/environment/strategies that "enhance" the user experience is critical. I also consider emotional design and aesthetics as "human factors" that are important for the designer to understand, and to then translate them into a tangible entity, especially in consumer products.

Design principles also play a critical role in creating a hierarchical system that allows designer and user to make sense of their tools and environment, although the application, interpretation, and definition of these principles are often subjective, loosely applied and/or purposefully "broken" for emphasis. The trick is understanding and applying multiple modalities, with the objective of the user experience. Informed intuition plays an important role within the design decision process.

The largest barrier in education is the reductionist strategies of academia. Other barriers are time; the industry's list of "needed skills" continually grows while programs tend to shrink. We introduce HF/E methods, but generally fall short of statistical data and analyses. In addition, not all design faculty are comfortable using HF/E within a design process.

Michael Lau: How does the HF/E community make inroads into the ID community? Are there projects that could be taught to a mixture of ID and HF/E students to force them to work together and produce a design that addresses a specific design problem?

Stan Rickel responds: Much more encouragement from faculty and employers to engage with the entire process is needed. Combined discussions, workshops and shared projects from all disciplines are good. Unfortunately, we tend to continue keeping separate divisions, conferences, educational silos, different parts of the building, etc. I believe that the collaboration perception scale is starting to move in the right direction, but moving this perception into action seems to be a mighty challenge. As we know, the collaborative process is often "messy", and certainly falls out of the budget/assessment line and makes spreadsheets break out in a cold sweat.

I am a strong advocate of mixing groups, courses and interdisciplinary experiences. Orchestrated chaos may ensue, but often the "magic" emerges. Currently we are attempting to create avenues for these experiences. Institutionally (at RIT) there is much conversation on interdisciplinarity and what that means and methods to pursue. There is also a push for access technology and accessibility projects which beg for interdisciplinary development framed around HF/E as the priority.

Challenges to the Industrial Designer

Esa Rantanen: Please suggest how HF/E education could better equip your HF/E counterparts for your interactions with them; that is, what is it that you wish the HF/E people would understand about your job to make your collaboration with them easier and more effective?

Alisa Rantanen responds: Although the end goal is the same for human factors engineers and designers (a safe, usable product), each have individual goals as well. For designers, these may appear more qualitative relative to the quantitative measures human factors engineers frequently trade in. Among other things, designers are responsible for creating desirability so the product sells

and must work within constraints such as established visual brand language, intellectual property, and manufacturing processes. It is important that these motives are not dismissed by HF/E professionals; rather, teams should be able to work together to compromise in cases of conflict. Education can play a role in understanding of respective goals that effective collaboration depends on.

Designers often rely on existing archetypes to ensure a product will appear familiar enough for a consumer to understand how to use it (in the absence of robust HF/E guidance), but this approach can limit creativity. Could a human factors engineer take a designer's "blue sky" idea and rein it back in to the realm of usability while still advancing the paradigm for that particular product? Of course, conservatism and reliance on archetypes occurs in both HF and design; the success of my theory would likely depend on teams' trust in each other's strengths and a willingness to go outside of their comfort zones.

Michael Lau: How is HF/E defined in an ID program? How is it emphasized or not in the curriculum? Is the concept of a human factors engineer even presented to students?

Alisa Rantanen responds: As I recall, my introduction to HF/E in school consisted solely of references to Dreyfuss (1960) without any structured HF/E training, which is telling in and of itself. Polling recently graduated colleagues on my design team, one noted that he still was not quite sure how to define HF/E while another described not one but two required courses in HF/E for her undergraduate degree in ID. Neither, however, was introduced to the concept of a human factors engineer.

Based (solely) on my experience and conversations with my colleagues, it seems most design programs take a reactive rather than proactive approach to HF. Students are typically instructed to use common sense to determine if a design is "intuitive," to ask classmates what they think, or to approximate the user's experience by donning props (e.g., an aging suit). HF/E concepts are generally addressed in school only when they surface in a larger project rather than being used to structure the effort, perhaps in part due to a tendency to simplify HF/E to anthropometry alone. However, cognitive HF/E offers great value in early opportunity identification and problem solving. Tools such as task analyses that build on cognitive ergonomics (beyond the emotive responses that designers are already familiar with) are instrumental in creating the bones of a good concept.

Stan Rickel: As a designer, what would you like to see HF/E programs learn about ID processes and methods? What advice would you give to me if I was creating a new ID program?

Alisa Rantanen responds: I would love to see more thought put into the communication of HF/E recommendations (Rantanen & al., 2014). Designers chose design because we're wired a certain way, just like human factors engineers chose HF/E for their own reasons. We therefore naturally have different modes of communication (e.g. designers are very visual) but cannot afford to get our wires crossed. To that end, HF/E education ought to consider the recipients of HF/E output and present content appropriately. Designers need actionable recommendations that take into account our unique goals and constraints and utilize the most effective and efficient communication styles.

With respect to HF education within ID programs, it appears that many rely primarily on common sense measures (e.g. ask a classmate what they think, put yourself in the user's shoes, etc; see my response to Michael's challenge for more). And this actually seems to continue in industry: it's my understanding that many design firms don't invest in HF expertise (I suspect Insight is an anomaly due to our work in the medical arena that is very much driven by the FDA, which is increasingly requiring HF documentation). Perhaps these firms don't see the ROI on hiring an HF engineer or team, and so a designer may be asked to wear that hat in a pinch. I don't mean to suggest all designs require maximum HF rigor, but it takes an understanding of HF to discern which ones do. Ultimately, knowing that HF tasks often fall upon designers, I believe an awareness of the appropriate level of HF attention for a given design is a critical component of design education.

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