

## **RESEARCH EDUCATION BY DESIGN: ASSESSING THE IMPACT OF PEDAGOGY ON PRACTICE**

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### **Introduction**

The value of research is increasingly recognized by the professional design world. However, despite the more prominent role of research in recent years, many common perceptions still exist that impede the complete integration of research into the creative design process in practice. Many of these perceptions are well founded in the practical realities of business, including severe limitations on time, human and financial resources. Others, however, are based on skepticism of the true need or value of research activities, a lack of knowledge of appropriate methods, or the fear of employing inappropriate methods.

Critical to the progress of design research in industry is the education of emerging designers. At the undergraduate level, there are opportunities to infuse the creative design process with integrated research activities, instilling a fundamental core of human centeredness in the approach to design. At the graduate level, education in specific methodologies and effective communication provides tools for strategic planning and the implementation of research into the design process, often reinforced by past professional experiences of the student.

This paper will present a pedagogical model for research education in design at both undergraduate and graduate levels. Graduate thesis projects that exemplify a human centered process will be discussed, along with those that propose specific concepts as persuasive arguments for building research into the professional design process. The critical impact of a research-based education is then examined, through reflective insights provided by former students now in practice, and from professionals, who hire and work with these students educated in human centered research and design.

### **Pedagogical Model**

The School of Design at Carnegie Mellon University offers undergraduate, graduate, and doctoral degrees. The Bachelor of Fine Arts undergraduate curriculum consists of a foundation year in design, followed by options for majoring in Industrial Design, or Communication Design. Two Master of Design graduate programs are offered, in Interaction Design, and a joint program with the department of English in Communication Planning and Information Design. Additionally, there is a joint masters program between Industrial Design and Mechanical Engineering, leading to the Master of Product Development degree. There is a new doctoral program in design with a specific emphasis on research.

Carnegie Mellon University is a research institution, and the School of Design operates under a human centered research and design philosophy. Specifically, students are exposed to an integrated process of research for the early-phase collection of information, ongoing concept development, and the testing of responsive design outcomes. Although some human and product use information may be collected from research literature and existing standards, there is an emphasis on direct interaction with people throughout the creative process using various research methods. Students are exposed to a human centered research and design approach in at least two ways, through specific content courses, and through reinforcement in complementary classes, studios, and projects throughout the curriculum.

Additionally, students may gain exposure to research-based design projects through sponsored client work in the faculty. For example, a multi-year project completed for the United States Postal Service (USPS) inspired organizational change through the redesign of the Domestic Mail Manual (DMM), using an explicit human-centered design process (Hanington, 2003). The project involved the transformation of complex information documents into accessible language and visualizations, in a new set of documents for use by postal employees, the public, and business customers. Students have also been involved with such human-centered research and design projects as appliance design for the elderly, packaging design for medication compliance, and the design of truck cabs for improved driver lifestyle.

At the undergraduate level, a required introduction to human factors is presented in the course *How People Work*. Previously required of industrial design students only, a significant shift in curriculum thinking now requires the course of communication design students as well. Clearly, the dimension of design should not be a barrier to addressing human need and desire. All students may also elect to take an advanced human factors project course, *How People Work with Things*. Together, these courses introduce a perspective on human centered research and design, with methods for the collection and translation of human information into creative solutions. The perspective and methods offered in these courses is complemented in several other courses, including design studies classes such as *Human Experience in Design*, studios such as *The Meaning of Form*, and several topic-specific seminars and senior projects, the latter often completed with industry sponsorship.

Introductory courses provide exposure to fundamental things that are necessary to know about human beings when designing for them, including physical ergonomics, sensation, perception and cognition in information processing, and personal, social, emotional and cultural factors. Projects in advanced courses and studios have explored such complex and diverse topics in research and design as mobile homes, footwear, recycling, public restrooms, grocery shopping, museum exhibits, learning tools, and emotional responses to product forms and operation. While many of these projects have an industrial design emphasis, communication designers are gradually integrating human centered research and design into newly revised curriculum as well. Recent elective courses offered in the communication design curriculum include *Understanding Perception through Design*, with an explicit connection to human design criteria.

At the graduate level, all first year students of the two-year program are required to take *Research Methods for Human Centered Design*. This course was introduced in Spring 2000 as an elective, and became required in 2002. A more recent change making the course unique is its integration with a required design studio taught in parallel. Students engaged in a semester-long team design project are exposed to “just-in-time” research methods, which are employed in exploratory investigations of people and products, co-design activities aimed at concept generation, and testing of emerging design ideas leading to final proposals. These methods range from ethnographic observation and immersive techniques, to participatory activities, to rigorous testing protocols.

Within the earlier model of *Research Methods*, students experimented with various methods through short research and design exercises, to gain experience in survey design, ethnography and observation, collaborative design activities, and prototype and product testing. The integrated studio model of the course incorporates a thorough research and design process, using flexible methods explored through application projects such as ubiquitous computing devices, and online

learning. Many of these projects are client sponsored, or have participation from interested clients.

Following their first year and the required methods course and studio, graduate students engage in a thesis essay and project conducted in their second year. Self-defined projects are guided in consultation with an advisor, and typically follow a pattern similar to that described for studio, with phases of exploratory, generative, and evaluative research and design.

### **Graduate Thesis Projects**

Graduate thesis projects serve to demonstrate the human centered research and design perspective in two ways. First, the nature of thesis investigations reflects the integration of human research in the design process. For example, a thesis working with the elderly to empower individual and social well being throughout aging revealed several design opportunities, and ultimately resulted in a web-based volunteer network among seniors (Whitlock, 2003). Other projects have a more stated product focus at the fore, such as a digital interface for collecting information in nature, including the identification of plants and animals (Kang, 2003). Both of these design projects were grounded in human and product research exploration, creative exercises with participants, and testing of emerging concepts with potential users.

Second, certain thesis projects have been developed for the express purpose of communicating research information to professionals in practice. Such projects are often inspired by the frustration experienced by students returning to school from industry, where they have been unable to make convincing arguments for integrating research into the design process. For example, *An Introduction to User-Centered Research: A Decision-making Toolkit for Your Organization* is a reference booklet containing text discussion, a glossary, method information cards, and interactive “decision wheels” (Rockwell, 2004). The tools provided in the book are intended to provide help in overcoming barriers associated with design research, to reduce uncertainty, provide opportunities for decision-making, and facilitate conversations with end-users. For example, one of the “decision wheels” helps to isolate methods appropriate for exploring or evaluating design ideas based on defined criteria, while another wheel suggests methods appropriate for selling points of research, and overcoming obstacles at various phases.

In another project, a student developed interactive software for understanding culture through exploratory research methods, facilitating the selection of appropriate methods for design investigations, and collecting notes and images (Weber, 2005). Multiple screens under topic areas of environment, economy, ideas and information, social structure, and technology provide basic definitions, questions to consider in research, and method descriptions. Interactive screens allow for building a research plan, and collecting research “assets”. While both these projects would need further development to gain contextual feedback in long-term use, anecdotally, preliminary responses from practice have been positive.

### **Reflections from Practice**

While certainly there is a compelling argument for research education in design, evidence of its impact ultimately needs to be witnessed in practice. To begin that process, in June 2005, two online surveys were distributed on surveymonkey.com. These surveys targeted School of Design alumni, and employers of design students and graduates, particularly those who have recruited and worked with Carnegie Mellon design students. Alumni returned 14 surveys; employers

returned seven (it should be noted that some employers were also alumni of the program, and in some instances answered both surveys). A series of eight open-ended questions were aimed at identifying key strengths and weaknesses of a research-based curriculum in design education, and the impact of research education and experience as evident in current practice. The surveys were intended to elicit reflective insight, rather than scientific or quantifiable data.

*Research is my current work. My design research education gave me a good base of knowledge and experience in different established research methods and approaches, as well as exposure to cutting-edge professionals. With this basis, I can help plan programs and select appropriate methods for each.*

Research education and experience are important to both employers and alumni in their current work. On a four-point scale, of 14 alumni participants, five rated both research education and experience as “absolutely critical” (score = 4), five rated education and six rated experience as “very important” (3), and three each rated education and experience as “somewhat important” (2). Only one rated research education as “not important” (1). Among seven employers, three rated research education and three rated experience as “very important” (3), two rated education and three rated experience as “somewhat important” (2), and only one rated research education as “not important” (1) (one respondent answered both as “N/A”). Employers responding to the survey characterized research as playing a large role in their organizations, in some cases equal with design.

*I do not believe I would have gotten this job without an education from a human-centered research and design program. A very important part element for a new hire here is a focus on human centered design.*

Among alumni, many felt that their education at a research institution, and in a human-centered research and design program, played a primary role in securing their jobs. Specific courses and experiences mentioned as having an impact on their research education, primarily at the graduate level, included the *Research Methods* course, *Integrated Product Development*, thesis projects, and studio. They also believed that the research reputation of the University and program was instrumental in drawing employers to the campus for active recruiting of students. Employers confirmed this attraction to the School, and in one case stated that they did not look at designers from other programs because they could not guarantee that they would have “the necessary understanding and appreciation for research that CMU designers have.” They felt that students hired from the program were able to participate in conducting research and apply it to design solutions, make arguments to program management and developers, and enhance client confidence in smart solutions.

*Every member of our design team is expected to participate in conducting research. A student that lacked a strong understanding of research would have a very difficult time succeeding on the team.*

The specific role played by research in current work of alumni included the design and execution of research studies, interpreting and applying research findings, using research to inform and validate designs, relying on feedback and inspiration from the user to guide ideas and processes, helping clients to “see the forest for the trees”, helping clients listen and learn from their users, and studying, learning, or analyzing a new organization. When asked what skills, knowledge, methods or processes are looked for when hiring or working with design students or graduates,

employers mentioned similar attributes, including a passion for advocating real people's needs when designing solutions, a strong understanding and some experience with different research methodologies, articulation of research process, and expressing how tangible insights from research were applied to create effective design solutions appropriate to particular audiences.

*User studies, personas, product prototyping, affinity exercises, heuristic evaluation, and, most importantly, failure.*

Among respondents, there was a clear consensus on the specific value of a research-based education in design. From both alumni and employers, it was indicated that strengths included a solid understanding of the human-centered design process, user empathy, recognition of the importance of research in understanding products, culture and society, approaching, researching and structuring problems, and finding connections. Specific mention of research methods evident in practice included user studies, interviews, surveys, immersive research, ethnography, observation, narrative tours, emotive inquiry, speculative scenarios, personas, participatory design, affinity exercises, card sorting, user reviews and tests, usability studies, focus groups, think-aloud protocols, and heuristic evaluation. General comments were also included that placed high value on the ability to avoid bias, putting research participants at ease, and evaluating and communicating findings.

*One needs to be able to justify design decisions with criteria that [are] established within the design field itself. DR [Design Research] is one way to explain what one's design decisions are and why they are legitimate. There is nothing worse, as a designer, than being perceived as someone that makes things pretty or nice once the real design decisions on a project have been made.*

Even among those who experienced less research emphasis in their education, and those who are working for companies that do not have a strong research history, expressed an appreciation for the value of research in education and practice. For example, a communication designer wrote that although human factors was not an explicit component of the curriculum at the time, it was learned “quickly and repeatedly that the user was the main ‘target’. That we should always design for the user, not for ourselves.” Another graduate of the program adds, “The application of research was almost nonexistent here at X. It's taken years to get them up to speed on how important research is to the design process.”

*Education deficiencies: Better understanding of how to process the raw data that comes from research and use it to both support the design process but also presenting the research for a business (non-designer) audience.*

Comments were also elicited on the deficiencies of design research education and practice, coupled with constructive input for improvements. First, both alumni and employers were critical of a less than complete understanding of the realities of business that sometimes dictate the need for research information to be acquired quickly and accurately, often not accounted for in tight budgets and timeframes. This was in some cases paired with a suggestion for more “real world” experience for students. Second, several comments were made suggesting that a gap still remains in the transition from research collection to critical analysis for design application, that a better understanding of specific and pragmatic processes used in research, would be valued. At least one suggestion was made for more quantitative research. Third, research qualifications among students in many cases were perceived to come at the expense of more proficient design work,

although one employer qualified this as a preference, stating that technical proficiency can be developed on the job.

At a general level, it was also pointed out that designers continue to struggle with a clear explanation of what 'design research' is to other researchers. There was at least some advocacy for even more research foundation, with additional focus on the design of research itself, knowing how to make it effective, and using it as a tool for innovation. It is particularly interesting that both employers and alumni made most of the foregoing comments in equal measure.

Remaining for future research and discussion to complement these results is to gain further input from employers who have not hired designers with a research-based education, along with students who do not have this component to their education, and students who experience frustration working in environments that do not support a research emphasis. To supplement the foregoing discussion that provides compelling evidence for the recognized value of research in design education and practice, additional knowledge of where research is missing in organizations may reveal reasons for its absence, and provide opportunities for continued expansion.

## **Conclusions**

There is indeed a positive outlook for the integration of research into design practice. The increased recognition of design in business may go hand-in-hand with an evident research core at the heart of the creative process, further counteracting the outdated reputation of design as styling. The convincing presentation of research as a necessary component of design that ultimately contributes to its value will be a key factor in building it into the business of organizations, even while recognizing the real constraints of time and resources.

Education has a critical role to play in this continued integration of research in design practice. Pedagogical models that introduce and reinforce a research component in design curriculum, and that respect the needs of practice, will benefit from the reward of well-employed students. In turn, graduates of research-based programs will contribute to the thoughtful design of products and services. Through exposure to research methods and processes in design, and concept exploration that may help foster the understanding and application of design research, we can equip our current and future designers with the necessary tools for balanced, creative, and human-centered design outcomes in practice.

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