DEVELOPING ADVOCATES FOR DESIGN: TAILORED TOOLS, METHODS AND RESEARCH EXPERIENCES FOR NON-DESIGNERS

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Abstract

Design has evolved to become an important strategic tool in business planning and development. Leaders who seek innovation have embraced design methods, including user research, visualization, and development of alternative futures, to inspire innovation. In education it has become equally important to stimulate innovative thinking through integrated interdisciplinary experiences. Industrial Design Fundamentals (IDF), a non-major course offered through the School of Design at Carnegie Mellon, offers a successful model that addresses these goals.

IDF helps non-majors to build a broader view of design through hands-on and engaging experiences. The course consist primarily of undergraduate students from a wide range of disciplines including; engineering, business, humanities & social sciences, human computer interaction, and psychology. It seeks to demystify the product design process and involve students in critical thinking and concept generation. Three interwoven goals support a holistic approach:

- *Visual thinking* — through tools and strategies developed by the author, students are taught the value of manual sketching, low-fidelity modeling, and imaging *User centered design* — each project introduces a different user (self, general, and target) to understand, direct goals, and expose opportunities.

- *Exploration*— strategies are shared for generating multiple ideas that shape complex information and lead to new discovery and innovative thinking.

To evolve knowledge and shape experiences, this course is structured around three progressive projects that explore small to large-scale products and systems. Underlying themes challenge students to give significant consideration to how humans interact with physical information (usability/human factors), understand specific needs (usefulness), and product appeal (desirability).

By the conclusion of the course, students gain insight into design. They begin to see how design connects within their field of study and the world. Many evolve to become advocates by sharing their course experiences with friends and peers. This exposure has contributed to making design more visible and valuable within the university community – increasing the attraction to design courses, strengthening already established partnerships, and generating new conversations on collaboration. Finally, these diverse students are entering their professions sensitized to design and design issues and may become future strategic partners through continued advocacy.

Keywords: Visual thinking, sketching, human-centered design,

Introduction

As societies become more visually driven, the skill to visually express information is emerging as a need and powerful tool for the average person. Historically, in the United States, art, design, and technical programs led in developing visual leaders – those trained as highly refined visual

shapers and interpreters. Today, however many programs are attracting a greater number of students who have limited visual experiences. There is a tremendous opportunity for programs – those who are not deeply rooted in traditional pedagogies –to respond with tailored experiences for this new student.

Industrial design education, an area known for managing complex visual information, is also attracting more outside students. At Carnegie Mellon, curious students come from varied disciplines across the university. They most often seek to develop visual skills that compliment developing knowledge, and to think differently about products and their relationship to the world around them. The Industrial Design Fundamentals course (IDF), a course for non-designers, is designed to provide such opportunities.

Course structure and goals

The course introduces non-design majors to design thinking and the discipline of industrial design. It is structured around three progressive projects that explore small to large-scale products and systems. Through lectures and discussions and team and individual assignments, students begin to experience and understand some of the essential thinking and communication processes of design. Underlying themes challenge students to give significant consideration to how humans interact with physical information (usability/human factors), understand specific needs (usefulness), and product appeal (desirability). Each project follows a streamlined design process of research, conceptualization, development, and realization while exploring ideas through active sketching and physical modeling in order to discover unique solutions.

The 18 students of the class meet twice a week for 110 minutes each session throughout 15 weeks. Meetings are held in a small lecture space furnished with rectilinear clustered tables, white market boards, fabric wrapped wall areas for work to be pinned up, and digital projection technology. The class adapts to the environment by transporting materials for each class.

3. Visualization as a strategic learning Tool

There are various tools, methods, and approaches used in design to create, shape and communicate information. Each is often its own area of specialty, both in education and practice, and offer opportunities for in-depth knowledge and discovery. This course explores tools and strategies that prove to be effective and efficient in helping students shape meaningful experiences that stimulate creative and critical thought. While many individual tools are used throughout the course, visualization is used as an overarching strategy for building connections that allow an uninhibited exchange between the mind and external world. Anderson defines visualization as a process of mentally constructing, shaping, and understanding varied information, and the ability to externally communicate it. This process extends beyond simply representing information visually using activities such as drawing, imaging (typography, photography, collages), or physical making. Rather it relies on these abilities as methods for thinking, conceiving, exploring, and proposing ideas. In essence visualization is the pathway for critical and creative thinking, and its communication[1].

[1] Anderson, E., Developing Advocates for Design: An introductory experience to industrial design thinking and methods of problem-solving.
Proceedings of The Engineering and Product Design Education Conference, Edinburgh, UK. September 16, 2005

[2] McKim, R., *Experiences in visual thinking*, Brooks/Cole Publishing Company; 2nd ed. 1980

4. Developing Visual Literacy

In order to engage students in the activity of design, visual strategies and methodologies for generating drawing and low-fidelity physical modeling, in an effective and efficient manner, are introduced. These tools are woven to build and sustain confidence while concurrently stimulating critical thinking and allowing ideas to emerge. Over the course duration, drawing and modeling skills evolve in conjunction with the needs as dictated by each project's complexity.

The broad ranges of disciplines typically represented in the course contribute diverse and exciting perspectives. However, very few have experience expressing information visually. Anderson's research at Carnegie Mellon has sought to respond to visual learning needs and opportunities. His research began investigating the visual needs and performances of industrial design students in undergraduate programs across the United States. It has further expanded to include engineering students and others through university course electives and visualization workshops with undergraduate and graduate students. This research has resulted in the development of flexible teaching strategies and methodologies that approach the needs of early students differently than traditional art approaches and expands on those of design. It has consistently helped students to communicate their ideas visually through manual drawing and physical modeling techniques that increase confidence, enable understanding, stimulate creativity, and are efficient and economical.

4.1 The value of drawing and modeling

Typically when one thinks of drawing it is thought of from either the artistic or technical approach. The images of beautifully illustrated works of art or highly specified documentations often come to mind. This reason is most students are introduced to drawing from one of these perspectives. However, neither represents the outcome goals of most visual thinkers, nor respond well as a tool for thinking, managing or creating complex information. As a result little value is placed in these areas. Design drawing is a third approach typically offered in programs of design, and in particular industrial design. It is an approach that better supports the broader visual thinker. Design drawing borrows from the art and technical domains to offer a balance of expression and structure. Its driving principle is form construction that enables cognition. By utilizing the design drawing approach, and placing drawing in the context of a tool for thinking and communication, the clarity of the idea becomes paramount enabling one to express information without overly critical assessment of artistic or technical merit. This allows inexperienced drawers to gain sufficient confidence and the ability to think, create, and express visually. As a foundation to drawing, basic form development is demonstrated using perspective and orthographic systems to stimulate holistic thinking during a single class period. After demonstrating the fundamentals, perspective grids[2] used to introduced orientation, proportions, and spatial relationships. Grids have consistently proven to accelerate learning, build confidence and focus energies towards ideas rather than struggling with drawing systems. On average students become comfortable generating drawings of basic forms in about two classes, a fraction of the time of tradition approaches. This evolving understanding and skill is immediately used in assignments and projects to realize ideas.

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[3] Gardner, H. *Intelligence Reframed: Multiple intelligences for the 21st century* Basic Books, 2000

[2] Pre-established lines printed on paper that shape a virtual space in perspective

Ideally, one negotiates between sketching and making to formulate, verify and modify representations of thought, and this is emphasized throughout. This activity helps in making a cognitive connection to both purposed and discovered information. Realizing that students will vary in their natural preference of tools, making is also encouraged throughout the process as both an initiator of thought and as a manifestation of concepts established through drawing. The goal of the model is to communicate physical and interaction intentions as clearly and effectively as capable. Though an aesthetically accurate model is not the goal, quality of construction of the abstract representations are expected to improve over time. Drawing is used in the final stages as support to information that is not easily modeled. Between drawing and modeling the full story of concept is to be expressed.

5. Projects and Strategies

Each project experience is designed to provide a platform for constructing increasingly complex information. Students are challenged to identify problems and carefully explore solutions that consider user interactions, use of materials, and visual and verbal communication. Rectilinear forms play a deliberate role in the first two projects and an important structural role in the third. The simplification of form factors enables the construction of two-dimensional and three-dimensional data (drawing & modeling) as an immediate response to ideas and deadlines. Conceptualization strategies are shown to generate multiple ideas that evolve from thumbnail sketches to refined line drawings. The deliverables at the conclusion of each project include a series of sketch models together with one that is more refined to represent a final; a bound book of all drawings depicting the process of thought; and a refined perspective line drawing that communicates details. In addition, each student makes a short presentation to the class and responds to critiques of their work. The projects that follow outline the major course experiences.

5.1 Designing for Self (personal desktop storage unit)

The challenge of the first project is to design a personal desktop storage organizer, based on a 9mm cube that addresses the following criteria: 1)
It must be able to support four personal items used in a work/study environment (items must be meaningful and not generic).
Thoughtful consideration on how the user interacts with it is of high importance. 2) It will sold in major distribution centers and therefore must be stackable vertically and horizontally in at least one state.
The forms and features must maintain a sharp/rectangular language
This project sets the stage for design inquiry. By designing a product where only the designer can know the answers, each student becomes their own expert. The initial challenge is to become sensitive to their own behaviors, both conscious and unconscious, in order to discover what questions should be asked of themselves to penetrate surface level solutions and discover meaningful opportunities. Concurrently they generate multiple concepts (beginning with 25 thumbnails) and through critical thinking, testing, and exploration evolve and distill their ideas down to a single proposal within two weeks. (Note: cardboard is used as an introductory material because it is informal and inexpensive)

5.2 Designing for Self + General User (large appliance information)

The second project challenges students to develop a new interaction that enhances the experience of using their kitchen stove. This involves analyzes and decoding the visual systems, and proposing a better interaction between the burner, indicators, and graphics. They begin by describing their stove through dimensioned orthographic drawings then translate that data into a perspective drawing and a ¼ scale form-core model. The model is detailed with graphic markings that indicate major features and presented during a class. The varied range of models enables conversations about visual, physical, interaction, and cultural differences, and how to approach these issues using design. This is the primary goal of the project.

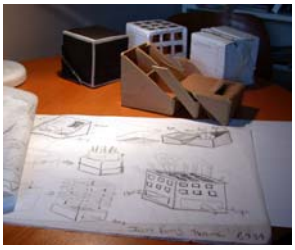
Secondary goals include the continued evolution of visual abilities and the broadening of creative solutions. In support of these goals the stove is selected because it extends the rectilinear form factors that began with the organizer. The addition of new forms, such as angles and simple radii to the appliance housing provide manageable complexity and contribute to building visual literacy. Further challenge is created by the requirement to design a control knob, which is centered on physical interaction and complicated in form. As students study the interaction opportunities of the control, and adjust to the significant changes in actual verses working scale, supporting human factors lectures and literature references are provided to aid their decisions. Additional visual and making strategies are also provided to respond to necessary tactile sensitivities. Non-hardening modeling clay is a helpful material in this pursuit. The final design requirement in this system is the iconic/symbol and text based information. Through researching past and present appliances, and other types of product interfaces, students develop awareness of the various systems and codes used to communicate and navigate users through product functions. They bring all aspects to completion with a full-scale partial section model and supporting drawings that describes the control and visual systems.

5.3 Designing for a Target User (electronic devices for elders)

The final project experience is to design an alarm clock for elder citizens. Using participants from an elder living facility located near the university, students visit and inquire about how this group understands, uses, and interacts with alarm clocks and related products. This is achieved in part by understanding their activities and routines together with their thoughts and desires. Research is an important driver for this final project. Various tools including questionnaires, interviews, observations, and engaging the user in making and storytelling are used to discover information. This data is then discussed and translated into concept proposals that are tested mid-way of the project with the same participants. Many students discover that elders have little need for an alarm clock. But through planned discussion they discover a chance to broaden the opportunity by rethinking its function and meaning. An example is to exchange the word alarm for reminder and use the same technologies to conceive of useful products that address unmet needs and desires. This is an underlying goal of the project.

The objectives are to gain a higher level of product reasoning and problem solving for a real user. Students learn by working in teams to research and discuss issues and opportunities that will inspire individual concepts. They then explore independent directions incorporating more advanced modeling using foam and clay to convey ideas and offer a final proposal. A concluding visit is made to the elders so they can respond to the proposed solutions offered by the class.

FIGURES 1-3. *Project examples*



1. Personal organizer models and sketches

2. Final stove, control and system concept

3. Final clock testing with users

6. Conclusions

The three project areas of the Industrial Design Fundamentals course at Carnegie Mellon have consistently evolved student awareness, skill of visualization, and sensitivity to design issues. By empowering the students to be designers, and engaging them in using visualization to stimulate critical thinking, they successfully address real problems associated with themselves and others. The varied challenges, discoveries, and discussions help them to understand that design is a deep and complex construct that takes special knowledge, thinking and training to shape appropriate questions, explore creative solutions and solve real problems. Additionally, many students appear to understand that design has connections to their own area of study. Others are taking design a step further and are enrolling in other design courses to extend their experiences. Many share their course experiences with friends and peers, which has contributed to making design more visible and valuable within the university. Such advocacy has strengthened already established ties between engineering and design by spurring new conversations about collaborative efforts and planted the seeds for others. It is hoped that many of these students will carry this experience-based education into their professions where they can continue to serve as advocates for design.

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Eric Anderson is an Associate Professor of Industrial Design, in the School of Design, at Carnegie Mellon University. Appointed in 1998, he teaches various courses in the undergraduate and graduate programs. His interest is in the area of visual literacy - studying how the tools of design drawing and modeling can cross disciplines to strengthen cognitive understanding and communication. Prior to joining the academia, he practiced industrial design for more than a decade working in both corporate and consulting environments in the United States. He received his B.S.I.D. from the Philadelphia College of Art, and his M.A. and MFA from The Ohio State University. He currently serves as the national Secretary/Treasurer of the Industrial Designers Society of America (IDSA).

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