An Interdisciplinary Design Education Framework

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Abstract: Over the last decade many educational programs have integrated methodologies of design thinking across a variety of curriculums. This has cast a welcome light on creative processes and facilitated innovative solutions. Faculty and students in the sciences, humanities, business and technology now have resources to explore new possibilities and solutions that match their technologic capabilities. However, this framework for creative problem solving falls short in teaching core design and aesthetic principles. The challenge for educators becomes how to build shared learning environments between design and external domains. As an assistant professor in the New Media Design program at Rochester Institute of Technology (RIT), I have applied core design curriculum in an interdisciplinary program across design, development and digital humanities to begin this shared design education. This paper explores how an undergraduate design curriculum can be leveraged across technology and liberal arts fields to provide actionable skills, design vocabulary and aesthetic appreciation to the design thinking and practice.

Keywords: Interdisciplinary, Pedagogy, Design Education, Shared Learning, Undergraduate Design Curriculum

1. Introduction

Over the last decade an explosion of educational programs has promoted and integrated the methodologies of design thinking across a wide variety of curriculum. This movement has cast a welcome light on the power of creative processes and helped facilitate innovative solutions across disciplines. Faculty and students in the sciences, humanities, business and technology fields now have the resources to explore new possibilities as “Design thinking, combined with scientific and technological thinking, allows us to explore the new frontier of design and innovation and to link design to the future through achieving the balance of desirability, possibility, and feasibility.” (Lou & Ma, 2015) While this philosophy is widely shared and is an important part of the “T-shaped” or “hybrid” educational model from undergraduate programs to the elite d.school: Institute of Design at Stanford it is also a developing corporate philosophy as John Maeda stated in the Design in Tech Report 2016 for KCPB, “… of the 2015 fortune 100, over 10% place design as an executive priority.”
With such prestigious programs and progressive institutions touting the importance of design and design thinking in education it becomes critical to examine how an undergraduate education can incorporate design without sacrificing the core skills required to gain expert knowledge in a primary domain.

The ability to create an innovative and cross-domain graduate is the new goal of many educational programs, but the challenge of creating a framework that balances high level design thinking with applicable core design, aesthetic principles and methods represents a deeper role that design must fill moving forward. Often the “T-shaped” concept places emphasis on the horizontal interdisciplinary or interrelated domains over the vertical core competencies. In contrast the core skill requirements for engineering, programming and other technical graduates have increased due to economic conditions and the breadth of emerging and changing platforms. Yet, industry continues to require graduates that possess interdisciplinary collaboration, communication skills and knowledge-bases of dependent domains.

These expectations and requirements have added to the academic curriculum mainly at the sacrifice of existing core skills. With mentoring models disappear in industry as workloads increase and billable hours overtake professional development, design programs stand at the forefront to help build stronger and more diverse educational experiences that foster creative and broader skillsets (Maeda, 2016). This paper will explore how an undergraduate design curriculum can be leveraged across technology and liberal arts fields to provide actionable skills, design vocabulary and aesthetic appreciation in addition to the design thinking methods.

2. An Expert or Generalist

Through over my 10 years of professional experience in User Experience Design at leading imaging, internet and digital product companies there has always been one constant. We do not design in a bubble, nor do we plan, manage, sell or code in isolation. The interconnected and agile systems of today’s industry and workflows require cohesive team collaborations from concept to deployment. This interconnection is what industry and education has rightfully latched onto in selecting the “T” shaped model over the traditional “I” deep core skill set that loosely leverages the 10,000 hours of training rule made popular by Malcolm Gladwell’s book Outliers and focuses on dedicated repetition of a single skill or field. The “T” shape model that introduces broader skills and knowledge from different fields should not be viewed as an alternative method but as an augmentation to the singular focused “I” approach.

The core expertise cannot be sacrificed in the “T-shaped” model at the undergraduate level but should be enhanced by beginning to introduce core competencies in interconnected fields and their applied use. Helping to show how connections are made across disciplines creates the foundation for future learning. As Michael Simmons wrote:

“Orit Gadiesh, chairman of Bain & Co, who coined the term expert-generalist, describes it as: Someone who has the ability and curiosity to master and collect expertise in many different disciplines, industries, skills, capabilities, countries, and topics., etc. He or she can then, without necessarily even realizing it, but often by design: Draw on that palette of diverse knowledge to recognize patterns and connect the dots across multiple areas. Drill deep to focus and perfect the thinking.” (Simmons, 2015)
This ability to dive deeper down an adjacent or unrelated field is key to creating a usable “T-shaped” individual and design is positioned to play a critical role in higher-education. Currently, Science, Technology, Engineering and Math (STEM) are the corner stones to our educational directives and there are numerous cross-overs from one field to another to support the “T-shaped” model that rely on each other for implementation but also offer a depth of vertical domains for students to explore. However, the crossover is typically utilized for core skill building or introductory general education courses that lack an applied connection back to the vertical core. This implementation represents itself as a breadth of knowledge but misses the opportunity to educate the student on how connections are made between the core and secondary domains.

Design thinking, individualized study and digital humanities programs have identified this disconnect and have begun to address this need primarily at the graduate level where students enter with a well-established vertical domain. However, at the undergraduate level these connections remain lacking and difficult to create as the primary focus remains on the vertical domain subject due to industry demands and career requirements. The inclusion of applied design curriculum offers an opportunity to introduce curriculum across STEM domains that introduces collaboration through communication and shared vocabulary.

The focus on STEM does not exclude creativity or problem solving because design is not listed. There are however aspects of design and creativity that are traditionally underexplored from such programs such as self-expression, visual communication, iteration and exploration. There is full support and requirements for basic literacy across the humanities and STEM disciplines without pause while design and arts foundation remain lagging and optional. It wasn’t until 2015 that STEM added art to become STEAM and was eligible for Student and Academic Enrichment Grants within the US. While some have delayed leveraging or even excluded design from the dialogue of building more diverse educational models, there has been a tremendous surge in incorporating applied design into an increasing number of channels.

Recently, Adobe Inc. has begun working with national higher educational institutes to supply Adobe Creative Cloud to all students with curriculum integration in English, Communication, Technical and Business courses as a tool to support building digital literacy for the next generation of content creators. This broad approach is doing more than introducing a new toolset, it is introducing design principles and elements as a new broad horizontal skill that can be incorporated into the students’ visual vocabulary, understanding and creative ability. In addition, a strong understanding and appreciation for the aesthetic qualities of visual and interactive communications assists all stakeholders in striving to achieve higher quality solutions and therein promoting quality design to the user. With an elevated sense of design and basic applicable skills, students are learning the fundamentals of design thinking through visual problem-solving exercises that reinforce the power of effective communication in a digital user experience based environment.
3. Why Design

Joseph Pine II and James Gilmore’s thesis on the “The Experience Economy: a business model that charges for the feeling customers get by engaging it vs a service business charging for the activities performed” (Pine & Gilmore, 1999) may not yet be realized but there is no denying the power of design on projecting an experience nor the value of design has on a business. Figure 2 the Design Management Institute’s annual Design Value Index illustrates how design is impacting the performance of corporations “implementing best-in-class design management practices…measured by six criteria:

1. Design operates at scale across the enterprise.
2. Design holds a prominent place on the company org chart, and either sits on the leadership team or directly reports to a leadership team member.
3. Experienced executives manage the Design function.
4. Design sees a growing level of investment to support its growing influence.
5. Design enjoys senior leadership support from the top tier of the organization.
6. The company has been publicly-traded on a U.S. exchange for the last ten years and thereby adheres to GAAP accounting rules.” (Kestin & Vonk, 2011)

This bottom line figures are transforming the evaluation of design skills and the role that design takes in the ability to leverage data through processing, visualization and communication customized for unique users and experiences.

The success of this design based and user focused business model can also be seen in the emergence of design co-founded startups. In 2015, 5 out of 25 of the top venture-backed startups had designer co-founders and 9 out of 25 in 2016 per KCPB’s 2016 Design in Tech report. The integration of designers from multiple sub disciplines and business models supporting their elevated role, support and necessity for design focused individuals has never been greater. At the same time the requirement for non-design technical, business and supporting counterparts to possess a design awareness and generalist ability also increases. “The creative minds who break the mold of what we’ve long considered to be a designer—the architect, the suit-maker, the graphic designer—are poised to shape big businesses the most.” (Maeda, 2016)

![Design Value Index 2005-2015](image)

Figure 2. The financial benefits of incorporating design and design philosophies across the corporate landscape have consistently outperformed similarly valued corporations as illustrated by DMI’s Design value index (Rae, 2016)
4. Design in Education

The challenge for educators now becomes how to build shared knowledge sets utilizing the individual’s domain expertise while maintaining a strong vertical design core for designers and non-designers alike. At RIT the New Media Design program has been servicing an interdisciplinary approach for bachelor of sciences based curriculums in New Media Interactive Development, as an integrated part of its design foundation for over 15 years. The New Media Design bachelor of fine arts curriculum approaches this service through integrated classrooms and courses with an equal representation from all programs. This cross-domain relationship now supports three additional technical programs from Liberal Arts Digital Humanities, Human Centered Computing and Web and Mobile Computing degrees in the foundation year with additional access to upper level design sequences that allow for non-design majors to dive deeper down a secondary vertical skill set. The success of this approach and program can be seen through industry integration into the classroom from partners such as Adobe Inc., Xerox, Eastman Kodak, Helios Interactive and Effective UI, design focused recruitment and placement with over 80 industry leading agencies such as R/GA, AKQA, CP+B, Ogilvy, Odopod, Firstborn, Barbarian Group, Adobe, Google, Microsoft, IDEO and alumni success in design and non-design related fields with major career paths represented in figure 3. Design is positioned as a leading force in education as more institutions look at “T-shaped” educational models, the need for skilled expert-generalist continues and industry support and corporate acknowledgement of the value of design integration grows.

Figure 3. With expanded horizontal skills and interdisciplinary backgrounds, undergraduate designers and technologists are securing work across a broad spectrum of industries and career paths.

There are three primary cross-disciplinary models commonly used in higher education. The first and most traditional is the foundation curriculum. This offers students a broad breadth of subjects taught as standalone subjects and serve to create introductory skills that are directly applicable to the core vertical skill set or act in support of the overall educational experience. This model is typically represented by foundation art courses for design students, humanities requirements, and math and science general education for technical degrees. The benefit of this model in creating a strong skill base along with creating a diverse knowledge base for future horizontal skill
development is well established and incorporated into most higher educational programs. However, design has not traditionally played a role within this model and therefore design principles, elements, design thinking and visual communication skills are absent in non-design curriculums’ foundational experiences.

The second model “concentration” is common within accredited academic programs through the integration of humanities concentrations and subject specific minors or tracks. This model allows students to selectively expand the vertical depth of a secondary subject by completing a sequential or related set of advanced courses. While this model does not necessarily relate to or directly influence the student’s primary vertical core skill set it does create opportunities for knowledge cross-over which can assist in the making of the expert-generalist.

The third model “collaboration” is experiencing a growth within higher education as a response for additional “T-shaped” horizontal skill development and to industry demand for team orientated collaboration. This model has taken on several variations; integrated undergraduate capstones, team-focused curriculums, shared cross-discipline courses, innovation centers, and inner-discipline mentorship programs. The benefit of these collaborations has afforded students to develop interpersonal soft skills and applicable experience of cross-domain integration. The challenge with collaboration is maintaining the balance between core vertical skill development opportunities and the benefits of a mixed educational environment that offers more horizontal skills. The depth of core “expert” skills remain the most employable attribute and any sacrifice of these must be weighed against the benefits offered by collaboration. Industry is not asking for fewer core skills, they continue to ask for more vertical core skills with additional broader knowledge. There is no sacrifice of one for the other.

While these models reflect common cross and interdisciplinary pedagogical models utilized across many higher educational institutes, they typically lack design components beyond a basic general 2D or art based foundation. Adobe, as noted earlier, is creating environments and campus resources to address this by helping universities bring tools and the foundational concepts of design through visual communication into a broad spectrum of classes. However, a deeper and more connected approach is required to fully leverage the benefit of integrated design education across a broader spectrum of subjects.

5. Design in the Core

Like most design programs the New Media Design program leverages foundations for humanities, 2D and art, concentrations for art history and advanced humanities and collaborations through research, industry and elective-based partnerships. As an applied domain with a long history of creating professionals the New Media Design program is structured around required sequences in visual design, motion graphics, programming and user interface & experience design. These core sequences guarantee that an in-depth and comprehensive vertical skill set is developed over the 4-year undergraduate degree. The system also offers a unique opportunity to be leveraged across multiple external technical degrees. The balance between meeting the program requirements while providing foundation and concentration level design courses illustrates an effective solution for expanding design education, practice and problem solving to a larger audience.
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Figure 4. A diagram representing how interdisciplinary relationships and shared learning outcomes contribute to a greater breadth during foundational learning. In addition to servicing multiple majors the design foundation creates opportunities for deeper design focused concentrations for external majors. The final collaboration courses foster cross-disciplinary opportunities without sacrificing core educational requirements.

Figure 5. Design thinking exercise: students define what design means to them and communicates the idea visually. During the project students follow a guided design process; ideation, research, exploration, and iteration. The guided design process introduces the core concepts of design thinking for use in non-design related projects.

Currently the New Media Design program supports four external bachelors of science degrees through multiple levels of engagement as well as the core design focused population as illustrated in
It is important to point out that unlike traditional service based courses between programs, these courses are taught to a fully integrated cohort with all non-design and design students together. Even though students enter with a wide range of visual, artistic and technical aptitudes from the four programs any curriculum challenges are outweighed by the benefit that the diverse cohort brings to the class. In addition, the core design program can leverage the in-depth sequential format of the full curriculum to reinforce any principles or elements that are specifically critical for the design student.

The first stage of support is in the form of foundation level support and is offered through two introductory courses that to the four majors. These courses involve a traditional tools and visual communications class that teaching image editing, manipulation with basic design principles and practices. This Digital Survey I course in the freshman year always accomplishes the task of bring the student populations to a similar level of technical aptitude while creating a shared vocabulary around visual communication, design and constructive critique. The second course, Digital Survey II, continues the visual design curriculum through the introduction of typography, grids and layout, type as image, gestalt principles, design elements and design principles. Through expressive and applied exercises, as illustrated in figures 5, 6, 7 and 8, students explore, iterate and critique. It is this deconstruction of visual language that students begin to first be exposed to the iterative, inclusive and explorative nature of design thinking. Design is at its core communication and students across all majors begin to see how this visual communication influences the viewer or user’s interpretation of information.

Figure 6. Student’s design thinking exercise: an introduction to a guided design process based on investigation, inspiration and iteration through the limited use of line and typography. With visual design principles and elements as the focus, design process is used to install a greater sense of how ideas and production evolve in problem solving. Project by Riley Yankowich
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Figure 7. Student’s design thinking exercise: a guided design process of exploration and iteration. Project by Ethelia Lung

Figure 8. Students conduct research about a designer or typographer and present their research to class. Based on the research they then create a typographic poster for a lecture series featuring their designer/typographer. This process introduces students to research based content creation and visual communication principles. Project by Cathryne Szczepanik
Teaching to such a diverse cohort does require some minor changes to the design curriculum, like limiting the need for hand drawing or graphic translation across the freshman experience. However, the programs sequential curriculum always for faculty to revisit or incorporate required design elements throughout alternative courses. The design content remains true to the core design program and the student outcomes and expectations are not reduced to accommodate non-major students. Over the past two years’ design and non-design majors achieve similar quality and maintain comparable grade point averages. This exemplifies the importance of teaching design for design and not as a service topic for non-designers. Foundation science, math or humanities are not taught for a specific group nor are they simplified for non-majors. The same must be held for design, the fear that this diminishes the field of design is unfounded and prevents visual communication and design principles from contributing to the greater educational experience and breadth of knowledge for students.

Figure 9. Infographic project: students research factual raw data which are related to social issues or procedural information. Using the raw data/information and its graphical form students develop their intended message in a way that engages the audience, provides information and convinces the viewer to seriously consider their point of view. During project students follow a guided design process; research data and topic, research design, ideation, exploration and iteration. Project by Lauren Carney, Noah Green, Riley Yankowich, Kelly Hurlburt and Luka Schulz

Figure 10. Interactive procedural information project: students create an interactive tablet application experience that effectively engages the user through appropriate interactions, imagery, flow diagrams, photo montages, statistical diagrams, medical diagrams, structural drawings or/instructions. The goal of project is to analyze and evaluate the values of user experience design for a dedicated display device and develop a strong, effective solution through a systematic design process. Prototype demonstration is a part of their final solution. Project by Melissa Samworth, Olivia Grace, Jacob Casson and Lauren Everson, Prototype examples - https://vimeo.com/145095420, https://youtu.be/NjKQe8GdV4U

With the shared design foundation completed these programs have access to expand their vertical skills though continued concentrations and collaborations. This concentration, like the foundation courses are incorporated directly into the design cohort. The advanced concentration courses are
core design skill building courses and all students are again held to the same outcome and performance as shown through student work in figure 9 and 10. Because of this philosophy there is a natural selection by the students that continue based on personal skills and dedication. Like New Media design students that select to concentrate in programming, business or humanities there is a personal ambition that drives their exploration. It is important to understand that the goal is not to make a non-designer a professional designer but to allow for the sharing of design principles and practice to a larger audience. To allow for more individuals to create secondary and tertiary vertical skill sets to the “T-shaped” education.

Figure 11. Interactive real-time data visualization project: the project is an exploration of the innovative potential of real time data forms and their advantages beyond matrices listing raw data. Students explore visual representation of data, examine principles for visualizing numerical information, and distill real time data in order to present them in a way that is easy to understand and engaging for the targeted users. Prototype demonstration is a part of their final solution. Project by Melissa Samworth, Jessica Schnell, Keila Olbrich and Neil LaVigne, Prototype examples – https://vimeo.com/110805366, https://vimeo.com/149816177, https://vimeo.com/115412991, https://vimeo.com/11883629, https://vimeo.com/121757001, https://vimeo.com/149517324

Figure 12. Interdisciplinary collaborations can leverage expert skills from design and technology fields upperclassmen through industry and research based projects. The examples in this figure explore musical creations, interaction and visualization through large screen interactions, virtual “air” controls and predictive analytics. The shared design and development foundation allow for teams to cohesively work together within these complex domain spaces. Project examples – https://www.behance.net/gallery/38491043/Beam-Beats-New-Media-Team-Project, http://evoxe.cias.rit.edu, http://encore.cias.rit.edu/#info, https://vimeo.com/165599120

Structured interdisciplinary collaborations are embedded into the junior and senior years to ensure that these initial shared experiences can develop through team based activities. These later collaborations allow for each cohort to apply their technical, humanities and design focused vertical
skill set together in research and industry sponsored projects with example work in figures 10, 11, and 12. By positioning the collaborations later in the academic career the curriculum focuses on horizontal skill development, interpersonal development, planning and project management while the students continue to expand their core skills within the context of the collaboration. The shared design focused foundation along with multiple concentrations across the student population foster a cross-discipline learning environment essential for professional success as expert-generalists. As illustrated in figure 13 this can be achieved by arranging subjects so that vertical and horizontal competences build upon each other in an effective and applicable way (Gerson & Ramond 2007).

![Undergraduate Design, BFA Curriculum Map](image)

### Figure 13.
In contrast to an open curriculum format, a more structured core sequence that accommodates required integration with external majors with shared foundation, concentration and collaborations allows the educational experience to meet the vertical core expert skills while offering strategic horizontal and secondary track exploration. Students have additional freedom to add additional tracks and concentrations even with such a prescribed curricular map as above.

## 5. Conclusion

Design education teaches how to leverage design and visual language to communicate across any device on multiples subjects for multiple purposes. The designer’s job and process is as a master of exploring external domains to find the most effective solution. Yet, in-depth design education has been locked to those enrolled in a design program or has been reduced to superficial levels when offered as a service topic. While industry searches for design leaders, design education has fallen behind on preparing design and non-designers alike to tackle these multi-domain environments and problems. Design education must play a key role through offering strategic design integration, interdisciplinary collaborations and allowing access for students to develop secondary vertical channels to elevate itself in education and industry. Industry has illustrated how design and user experiences can be utilized to separate a product from the competition, design education must follow and create design based learning opportunities across broader domains in education. The expert is the goal for employment but the generalist is the key to knowing when an expert is required. Introducing design across domains creates a higher awareness within the market for design experts to flourish.
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