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Design Thinking, An Examination of Epistemological Frameworks in an Area of Academic Study

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Abstract

The ambiguous identity of the digital media field, the ubiquity of media, and rapid and persistent technological change and innovation pose inimitable challenges for academic programs in digital media. Digitization of media is an underlying impetus for today's rapid innovation that compels related academic programs in higher education to re-examine themselves to keep pace and to better understand their epistemological foundations. Digital innovation helped spur renewed awareness of human-centered design to solve ill-structured, highly complex problems. Design and Design Thinking (DT) provide a potential framework to aid in academic program assessment. In this paper I explore precepts of design and DT as a potential frame of context to aid in curriculum design. I present a case study example that examines the process to assess a digital media curriculum using a DT framework, an iterative process involving students, faculty, and academic and industry partners.

Keywords

Digital Media, Design, Design Thinking, Design Process, Design Iteration, Human-centered Design, Assessment.

Introduction

Over the past 35 years colleges and universities worldwide created academic degree programs in new media, and a host of other titles. Many universities recognize that the field evolved into an established academic area and therefore offer related majors (Ryan, et al., 2014). New media or digital media, as it is commonly referenced today, involves an array of approaches and disciplines (Sterne, 2005), influenced by psychology, computer science, art, design, media studies, human-computer interaction and communications. Scholars differ about what constitutes digital media, which contributes to the field's indistinct professional identity (Huang, 2009; Peters & Nielsen,2013). Digital media curricula in communications, computer sciences, and art departments can have disparate emphases ranging from broadcast media to interactive applications and gaming, to visual aesthetics and artistic expression. In terms of topics, historical framework, literature, research and even definitions of the field, an introductory digital media course as part of a similarly titled major (i.e., Digital Media, New Media, etc.) offered through an art department will likely be quite different compared to an identically titled course and major offered in computer science or communications. This may also be true within academic programs of study. Within programs, philosophical viewpoints about what constitutes knowledge in digital media and how it can best be acquired often vary. The epistemological frameworks that determine relevant phenomena to study, methodological practices, types of evidence, research goals, assumptions and fundamental beliefs about the discipline, among other things, can differ (Brister, 2017), having significant implications for programs, faculty, and students. Differing epistemological frameworks as well as the breadth and diversity of curricula, while not uncommon in higher education, may be emblematic of the relative newness of digital media as an area of study, the ubiquity of media, and the lack of

clarity as to what digital media or new media represent. These factors are particularly noteworthy today as universities face much competition for students and, at the same time, they must increasingly demonstrate their value to students and ability to prepare them for professional life (Huq & Gilbert, 2017).

Compounding these issues, many digital media programs endeavor to be technologically up-to-date and at the forefront of innovation. Manovich (2001, p. 20) notes, "new media represents a convergence of two separate historical trajectories: computing and media technologies". The digitization of media is an impetus for pervasive innovation and change, transforming industries and related work methods and practices as well as consumer behaviors. The rate of change and innovation poses unique and complex problems for business and educational institutions, many of which have sought to expand their means for addressing them by turning to design, specifically Design Thinking (DT), to effectively respond to as well as think creatively and rationally about innovation (Chaplin, 2016a; Chaplain 2016b). DT is a human-centered, collaborative, and holistic design process (Willness & Bruni-Bossio, 2017). As Dorst (2011, p. 521) points out, "Design Thinking has gained popularity - it is now seen as an exciting new paradigm for dealing with problems in sectors as far afield as [Information Technology] IT, Business, Education, and Medicine." Applications of Design Thinking in education can be found from K-12 through graduate studies (Pande & Bharathi, 2020). Anderson et al. (2017) point out that while DT has been used among technology and consumer goods companies, hospitals have used it to improve patient experience and outcomes.

Purpose

In this paper I explore precepts of design and DT as a potential framework to aid in curriculum design. I present a case study example that examines the process to assess a digital media curriculum using a DT framework, an iterative process involving students, faculty, and academic and industry partners.

Background and literature

The Digital Media Arts (DMA) program was formed in the mid-1990s and it offered two study concentrations, Multimedia Development and Web Development. Students choose one concentration and must complete nine required courses (27 credits) and three elective courses (9 credits) specific to their chosen concentration. As the digital media discipline evolved and it became increasingly ubiquitous, the department faced constant innovation and rapid technology change. There were several external and internal influences that served as the impetus for a re-examination of the core foundations of the program, some of which are discussed below. These forces affected curricular decisions, teaching, resource funding, and ultimately the direction of a program.

External and Internal Influences

New and emergent industry practices and methods resulting from digitization proved to be disruptive external influences on the program. As technology and related methods changed, the program needed to adapt. Rapidly, industries and society in general acclimatize to digital content creation with eventually almost all media created digitally. Software and hardware became integrated and easier to use. Questions about teaching technical or craft skills (e.g., hardware, software) versus higher order thinking and problem-solving pose challenges for

academic programs of an applied nature as the industry's need for craft skills is often at odds with university missions (Huang, 2009).

There are also questions about the extent to which digital media is perceived as a primary discipline or a subdiscipline. Golumbia (2014, p.54) points out that "the field of digital media can be arguably understood to be so wide as to encompass virtually everything." This creates uncertainty for individuals inquiring about these academic programs. It also alters the nature of the curriculum and course topics. In response to transformations spawned by media digitization, academic programs approached the study of digital media distinctly. For some programs, digital media was the primary or foundational concentration of study. The program culture and curriculum derived from core precepts of digital (programmable) media, new media theory, technology, media creation software as well as design and production. Conversely and perhaps more commonplace, many academic programs, in reaction to the pervasive impact of digitization on almost all disciplines, seemingly adapted aspects of digital media as a sub-domain wherein they educated students in a primary area of study such as communications and then helped them understand how new digital practices (the sub-domain) integrated to it. Because digital media impacts most disciplines, the degree to which it is a sub-discipline or a support discipline is particularly important, as this shapes the academic approach and nature of the curriculum. This was an unforeseen obstacle for the department and a key underlying facet in the re-examination of the curriculum. Questions arose about definitions, perspectives, and beliefs regarding media. At times, there was uncertainty about the extent to which courses should focus on digital culture, design, and computation more generally versus media in the context of media communications industries, mass media, advertising and public relations.

In response to these challenges, the DMA faculty endeavored to assess the major to ensure there was a shared epistemological framework and mission. It is not uncommon for faculty to possess diverse professional and academic training, often from outside the field. They may hold distinct philosophical views about what digital media are and the direction of the curriculum. However, this disparity in thinking about digital media was another unforeseen obstacle and key facet in decisions to partake in re-evaluating the curriculum. Without a shared epistemological framework, language and knowledge of a field's fundamental positions and assumptions, it is susceptible to influence and critique (Werner, 2018).

Digital media programs are influenced by other disciplines (e.g., computer science) that are generally stable and less disruptive to curricula. They are also impacted by industry "craft" knowledge and skills that are dynamic influences, susceptible to digitization, requiring programs to adjust rapidly. The challenges of curricula assessments and planning, already multifaceted are compounded by the effects of media digitization and exacerbated by the field's lack of clear identity

Design

Design is the realization of the human aptitude for intelligent action (Galle & Kroes, 2015). It is the purposeful creation of products and services that fit human needs (Norman & Klemmer, 2014). Design focuses on potentiality or "how things ought to be - how they ought to be in order to attain goals, and to function" (Simon, 1996). Key tenets of design include systemic thinking, focusing on individuals and listening to them to identify core problems, experimentation and ideation, testing, and iteration. It is the conceiving, planning, research,

and making of things, such as products, ideas, interactions, services, systems, applications and more. People identify design as a process of thinking, germane to any profession (Nielsen & Stovang, 2015) and not solely the purview of professional designers. Gibbsons (2016, para 3) notes, that a human-centered "design approach proved to be a differentiator: those companies that used it have reaped the financial benefits of creating products shaped by human needs." There are several DT frameworks (Dam & Siang, 2017), one of which is the five-stage process model proposed by Stanford University's d.school. The model stresses a human-centered and holistic focus, moving from divergent to convergent thinking, collaboration, creating prototypes that are refined through successive design iterations and understanding the context in which design is to takes place. DT generally include the following stages:

Empathize: Design team attempts to identify the core problem(s) from the perspective of the people most impacted. It is essential to learn about the people affected by the problem - their interests, needs, behaviors, among other things.

Define: Analyze and synthesize the observations or data collected in the Empathize stage to fully understand the central problem(s).

Ideate: Design team generates ideas or possible solutions to solve the problem.

Prototype: Team produces multiple inexpensive versions of the design solution, as quickly and easily as possible. These "rough" versions of possible solutions help the team investigate the efficacy of ideas generated in the previous stage.

Test: Team thoroughly evaluates the completed design.

Despite growing interests in DT, it is not without critics, with some asserting that it is limited, and approaches design superficially (Chaplin, 2016a). However, proponents see it as harnessing a design methodology by multidisciplinary teams, often non-designers, to a broad range of ill-defined highly ambiguous innovation challenges (Seidel & Fixson, 2013). Moreover, it is a highly iterative process, based on learning through experimentation (Liedtka, 2015), and it can be used by non-designers, which is appealing for faculty committees of non-designers charged with designing academic programs and curricula. As Brown and Katz (2011, p. 381) note, "A competent designer can always improve upon last year's widget, but an interdisciplinary team of skilled design thinkers is in a position to tackle more complex problems."

Method

Five faculty members (design team) of the DMA program initiated the curriculum re-design process. It originated from informal conversations about changing dynamics of the field, courses, course enrollments, student progress and reactions to class activities, and how to adapt.

An important factor was how to begin. The team met initially and while the discussions were fruitful, many divergent work paths emerged. Members struggled about a clear direction, which was critical given the limited time the team could devote to the project.

Cognizant of the constraints under which the team had to work (i.e., existing faculty and research commitments, no external mandates), members endeavored to identify an approach

that was readily understandable and straightforward to implement. Lawson and Dorst (2009) note that models depict processes and can help organize design work and enable non-designers to comprehend the practice, even if in a limited way. To provide understanding of the macro-level processes the team might engage in, one member explored influential instructional design models such as ADDIE (analysis, design, development, implementation, and evaluation) and curriculum design models such as Tyler's (1949) objectives model; and Saylor, Alexander, and Lewis' curriculum administrative model (see Saylor et al., 1981; Lunenburg, 2011). Additionally, outside the educational realm, approaches and practices such as The Frame Creation Model (see Dorst, K. and Stolterman, E., 2015) and Design Thinking frameworks were examined. The team ultimately chose a DT approach to frame their work because it seemed to provide an understandable approach about how to proceed. Moving from broad to specific concepts, which is characteristic of design thinking (Willness & Bruni-Bossio, 2017), it collected information from national and regional programs and then engaged in a self-study of DMA.

External academic program review: The team reviewed 56 digital media-oriented programs at 49 schools in the United States to learn about courses, program structures, language or terminology used, and program descriptions. Huang (2009) identified 182 digital media-oriented educational programs. Using Huang's list, the team initially identified programs with titles like the program, such as digital media, multimedia, interactive media, and media arts. A review of descriptions and courses was conducted to ascertain related programs. There were several programs with similar titles but quite different emphases. For instance, a program might be titled digital media, but it emphasized film or gaming. Additionally, the team conducted Internet searches for programs and collected the following information:

- Type of degree BS, BFA, BA, name of degree
- Total credits required
- College, School in which program is offered
- Department in which program is offered
- List of courses noting any concentrations
- Topics covered in courses
- Title of courses

Job descriptions: To obtain information about the types of "craft" skills and knowledge required by employers, two team members reviewed position announcements. They searched using keywords such as digital media, new media, multimedia, design - user experience, interface design, and web, photography, and video. They extracted keywords from these announcements related to required skills and knowledge.

Interviews

Faculty: A team member interviewed each of the DMA faculty (4 faculty members) to understand how they viewed the DMA program and their perception of its mission and goals. The interviews lasted approximately 1 hour, during which the interviewer asked them to briefly describe the program and define its mission and goals. Approximately 1 month after the interviews, faculty participated in multiple group brainstorming sessions.

Students: The team member conducted individual "exit interviews" with a small number of graduating students to obtain feedback about the program. In an open-ended discussion, the interviewer asked students to provide feedback about courses, the major, and the curriculum.

External programs chairpersons, faculty, and professionals: The team member interviewed 12 individuals external to the university who had knowledge and experience in digital media. As described earlier, the team reviewed 56 digital media-oriented programs at 49 schools. A team member interviewed five program chairpersons and three faculty members from those programs. The interviewer also interviewed four business and industry professionals. The interviews were conducted face-to-face, or by telephone or email.

Interviews with faculty and chairpersons focused on the following topics:

- Type of degree BS, BFA, BA
- College, School in which program is offered
- Total credits required
- Program and courses titles
- Program philosophy/emphasis, mission, focus, and goals
- How did program determine the topic areas in which to offer courses?
- Topics covered in courses
- Curriculum - types of courses, sequence of courses
- Program identity – how does the program identify itself e.g., news media, computing, art, etc.

Interviews with industry professional focused on the following:

- Knowledge and skills expected of graduates
- Titles of program and concentrations that attract interviewees when hiring
- Curriculum – courses or course topics that help graduates in the industry

Brainstorming Sessions

Over a sixteen-week period, the faculty who teach in the major met weekly for brainstorming sessions typically lasting 1 hour. A facilitator presented an initial set of problems/issues related to the following:

- Program identity - mission, focus, and goals
- Program competitiveness and viability, relative to other programs in digital media
- Areas of the field for which students are being prepared
- Theoretical base that informs the curriculum
- Curriculum and programming issues
- Industry trends and their impact on teaching and learning

Data collection and analysis

The team reviewed 56 digital media-oriented programs at 49 schools in the United States and twelve of these schools were within the same geographic region as DMA.

Program titles varied. Digital Media was the most common title, with seven programs using it. Digital Media Design, Interactive Media, and Multimedia each occurred multiple times. Most titles were general in nature and did not focus on a specific media (photography, video). Table 1 presents a list of program titles. If titles reflect the overall emphasis of programs, then design, digital, interaction/interactivity, and media are areas of focus in the 56 programs reviewed.

Table 1. Program titles.

Comm, Media & Technology	Digital Multimedia Design	Graphic Design	Interactive Media Studies
Computer Science/New Media	Digital Art and Design	Integrated Digital Media	Media Art & Design
Converged Media	Electronic Design & Multimedia	Interaction Design	Media Arts
Design for Interactions	Electronic Media	Interactive Design and Game Dev	Media Arts – Web Design
Digital Arts	Emergent Digital Practices	Interactive Design | UX | Experience	Media Arts & Technology
Digital Arts & Multimedia Design	Emerging Media Technology	Interactive Digital Design	Media Comm
Digital Design	Film and Digital Media	Interactive Digital Media	Multimedia
Digital Media	Film and Digital Technology	Interactive Media	New Media
Digital Media Design	Film, TV, and Media Arts	Interactive Media and Game Dev	New Media Design
Digital Media Production	Graphic and Interactive Design	Interactive Media & Web Design	New Media Interactive Development
			Web development

Most (50%) of the 56 programs were offered through the *College of Art and Sciences/Architecture*, followed by *Schools of Communication/Media* (24%), and *Computer Science* (10%). A smaller percentage were found in Management Information Systems (6%), Engineering (5%), Liberal Arts (3%), and General Studies (2%). Programs in *Arts and Architecture* offered courses with an art emphasis; programs in *Schools of Communication/Media* emphasize TV and news, writing, and programs in *Computer Sciences* emphasize technology and programming.

The primary program degree types were Bachelor of Arts (41%), Bachelor of Science (27%), Bachelor of Fine Arts (22%), and Bachelor of Design (5%). One school offer a Bachelor of Technology and another a Bachelor of Information Science.

To obtain a measure of the topics emphasized in programs, the design team compared course titles or areas of emphases of the *Multimedia Development and Web Development* concentrations to national and regional schools by searching the curricular of the 56 programs and noting course titles (e.g., video, animation, etc.). For example, in Table 2, of the 56 programs reviewed, 43 (77%) included Design in a course title at least one time. It should be noted that within some topics there was a range of sub-topics. *Design* includes design courses, web design, visual design, and interaction design, among others.

Table 2. 15 most reoccurring topics in curriculum by program

Most reoccurring topics	Percent of schools including course topic in curriculum
Design	77
Graphics | Illustration	70
Web	66
Video	59
Animation	52
Interaction | interactivity	52
Programming	50
Imaging	46
Multimedia	46
Photography	45
Production	43
Interfaces| HCI | UX	43
Audio	41
3D	34
Gaming	32

It appears that curricular are generalized. Rather than specializing in a specific topic area (e.g., video) programs cover several topics (see Table 2). On average, each program offered courses that address 8 of the 15 most reoccurring topics. Of the 15 most reoccurring topics, the fewest number covered in a curriculum is 4 and the highest number covered is 13. This does not mean that programs do not allow for specialization; within the reviewed programs, students can specialize. Interestingly, the words in many course titles tend to be media specific. The most popular terms do not emphasize processes, such as managing or designing.

Using the same procedure as when identifying areas of emphasis in all programs, the team reviewed 17 programs at 12 regional schools to identify topics emphasized. Table 3 shows the 15 most reoccurring topics by national and regional programs.

Table 3. Most reoccurring topics: National and Regional

Percent of schools including course topic in curriculum			
National programs (N=56)	%	Regional programs (N=17)	%
Design	77	Graphics/Illustration	76
Graphics | Illustration	70	Design	65
Web	66	Web	65
Video	59	Photography	65
Animation	52	Production	59

Interaction | interactivity	52	Animation	53
Programming	50	Interaction/interactive	47
Imaging	46	Video	47
Multimedia	46	Imaging	41
Production	45	Communication	35
Interfaces| HCI | UX | Mobile	43	Programming	35
Photography	43	Multimedia	29
Audio	41	Print	29
3D	34	Portfolio	29
Gaming	32	Audio	29

Job descriptions: To obtain information about the types of skills, knowledge and technologies employers required, the team reviewed position announcements from sources such as ZipRecruiter, HigherEdJobs.com, User Experience Professionals Association, Monster, and CareerBuilder. Table 4 presents a list of descriptions categorized broadly as Multimedia, Digital Imaging, Video & Sound Production, Web Design and Development, Interface Design & Usability, and UX – Interaction. Position descriptions tended to include references to theories, principles, methods (TPM), applications (APP) or applying principles, and tools (e.g., software, hardware) and these are indicated in the table.

Table 4. Skills and knowledge listed in employer position announcements

	Multimedia		
TPM	Multimedia, hypermedia	Multimedia Design/dev processes	Multimedia, new media theory
	Graphic Design for print and digital	Interactivity	Emerging Trends
	Web, branding, typography, layout	Best practices	Multi-platforms
	Analytics digital advertising	Social Media	Portfolios
APP	Media types; optimization	Compression, encoding, online del.	File formats-graphic, video
Tools	Media Design Software	Photoshp, Illustr, Premiere, InDesn	HTM, CSS, JS, Frameworks
	State-of-the-art technologies	Professional image acquisition	Lighting equipment
	Digital Imaging, Video & Sound Production		
TPM	Production, storyboards, scriptwriting,	Videography, film multiple settings	Documentary film
	Video and podcast production	Edit/optimization-vid-aud-images	Experience with media types
	Write stories to creative standards	Motion formats, visual approaches	AV streams; Organize assets
APP	Digital media compression, encoding	Formats and codecs; Transcoding	Stream, formats and codecs
Tools	3D Animation (e.g., 3d Studio Max)	Video and audio editing	Photoshp, After Effs, Premiere
	Video, cinematography	Professional video acquisition eq.	Proficiency with lighting
	Web Design and Development		

TPM	Theories, models, processes	Gestalt, Visual design principles	Color, composition, space, type
	Color theory; Information theory	Human perception-factors	Typography
APP	Web design, dev., eval start-finish	Web guidelines	Responsive desgn; Mobile-first
	Accessibility; Section 508; W3C	SEO	Analytics
	Wireframing	Flow diagrams	Site maps
	Use cases	High-level prototyping	Test, verify results and implt.
	Media optimization	File formats	All mobile platforms
Tools	HTML, CSS and Scripting; framewrks	Page layout, Styling Techniques	JS, XML, PHP, MySQL;
	Interface Design & Usability		
TPM	Usability Engineering	ID Theories	Design methodologies
	Navigational models; Infor arch.	UI development	Human Factors
	UI, layout, type, and iconography.	Gestalt	Human centric design
	Rapid prototyping and methods	Agile	Ui design trends; best practices
APP	Front End analysis, requirements	Research tech, interview, focus grps,	A/B Testing
	User interviews	Task analysis	User scenario development
	Card sorting	High-level use case definition	Usability techniques and tools
	UI/Prototyping, storyboards, doc.	High-level prototypes	Heuristic evaluations
	Wire framing	Flow diagrams	
	UX - Interaction		
TPM	UX processes	Interaction design; IxD Theories	UX experience design; HCD
	Research methods, tools; Eye tracking, user observation, task coding	UX research, Experimental design, Empirical evaluation; data analysis	Evaluation; Usability research studies, testing and information architecture
	UX methodologies/best practices	User action framework	User task analysis; Use cases
APP	Process-Flow; journey; affinity	Responsive design; mobile-first	Front-end and interface dev
	Personas	Card Sorting	Wireframes
	Development Methods; Agile	Web and mobile app design	File formats; Media optimize
Tools	Prototyping Tools	Mobile applications	
TPM: Theory, Principle, Methods		APP: Applications of TPM	Tools: Tools used

Interviews. A team member interviewed 12 individuals external to the university who had knowledge and experience in digital media. Table 5 present a summary of main points and categorization of their commentary. Key points about curriculum design include iteration or continual refinement, faculty involvement, and planning for change and the future.

Table 5. Interview commentary summary

Faculty involvement
Work internally within faculty resources - curriculum grounded in faculty expertise. Faculty came up with curriculum. Faculty with expertise in area of curriculum take ownership and share curriculum ideas with faculty.
Ask specific people to take charge of areas and report back to group.
Did not hire external reviewers.
Characteristic of curriculum
Cohort program. Portfolio. Must include theory and development/production; theory courses and basics programming courses.
Offer an applied course each semester. Students should be able select courses based on educational-career path so they can discover their strengths and identity. Flexibly for students.
Making curriculum revisions
Define mission immediately. Identify general objectives so everyone "buys in".
Generic course titles so you can change.
Survey professionals to help guide process. We compiled and studied existing program curriculum, talked to colleagues in other programs, and then met as a faculty to brainstorm.
Course and content decisions made by Chair with interested faculty and staff.
Try things and revise – convey that it is not the "final version."
Make changes continuously. Meet often. Everyone needs to be involved. Be patient with the process. Takes time
Students
Students create a portfolio. Program should provide for students to evaluated so they can revise portfolio.
Scope
Think broadly. Include all segments in department. Use as many elements in department as you can to give students rounded education. It is heavily art and maker focused.
Program Management
Staff member works with recruiters to ensure student internships and careers options and advises students.
Change
You must plan for change. Plan so you can sustain program.
Curriculum Standards
Identify standards ACM and learning outcomes.
Community
Built connections with community. Staff work with recruiters to ensure student internships and careers options.
Evaluation
Make curriculum revisions at least 5-7 years.
Future
Plan for those who will succeed you.

Define and Ideate

These data provided a broad perspective of the field, types and names of programs, what the industry is looking for in graduates, and how other programs design and reformed curricular. The team reviewed data and identified the following opportunities for innovation. For each opportunity, an idea (Ideate) is provided directly below it.

1.*DMA Program purpose*. From interviews and brainstorming sessions, it appeared that a clear, shared mission or purpose statement was needed, as was clarity about terminology. Faculty had distinct perceptions about digital media and the DMA program's purpose. The following key goals were identified:

- Ensure DMA is (continues to be) one of the best programs of its kind
- Formulate (reaffirm) a common definition of who we are
- Define (re-articulate) the mission and goals of a DMA education
- Define (re-examine) what it means to be DMA graduate in terms of skills, knowledge, career paths
- Examine (re-formulate) the DMA curriculum in the context of our mission, goals, faculty strengths, industry trends, the academic milieu, and the characteristics envisioned for DMA graduates
- Maintain a viable curriculum that is coherent and reflects the industry and discipline

Ideate: Define a program mission that guides curriculum design and ensures that: a) curriculum serves the needs of students; b) students and faculty understand and share in the mission and character of the program; c) all courses relate directly to the mission; d) all curriculum changes and associated information materials derive from the mission; e) the curriculum appeals to designers, developers, and technologists and reflects industry practices.

2. *Greater alignment between program mission and industry "craft" skills and knowledge*. Students, faculty and industry partners expressed interest in ensuring that students understand and possess the "craft" skills and knowledge needed for professions in digital media and design.

Ideate: Form an advisory board to engage industry professionals and faculty to provide input about the curriculum and the DMA major.

3. *Categorization of course types*. From the interviews and brainstorming data, the team determined that over the years, in response to innovation, the objectives of the DMA concentrations evolved but the titles (Multimedia Development and Web Development) did not reflect this evolution. Both concentrations emphasize design (and related methodologies) with one concentration (Multimedia Development) focusing on visual information design and the other (Web Development) focusing on interaction design - using digital media to design interactive experiences that support human (users) tasks. Additionally, to attract student interests and convey the leading-edge character of the program, some course titles reflected technology innovation or software trends that in time become dated.

Ideate: To effectively communicate to our audiences, modify the names of the concentrations from Multimedia Development to Digital Media: Visual Communication and from Web Development to Digital Media: Interactive design and media. These titles were proposed by industry partners. When appropriate, add Studio (design studio, development studio, and video production studio) designation to course titles, to reflect the core nature of the subject rather than titles based on trends or software.

4. *Emphasis of digital media across concentrations*. From the analysis, while the concentrations emphasize design (visual and interaction design), there appeared to be a de-emphasis of media integration and classroom instruction highlighted mainly media topics specific to a

concentration. For example, the Web development concentration accentuated interactivity, databases, scripting or coding. Media formats and optimization were presented to a lesser degree and, when presented, they pertained to deploying interactive applications.

Ideate: Effectively integrate media (e.g., video, sound, animation, images) across concentrations. In introductory courses, ensure development of student proficiency in general digital media topics. Concentration courses should underscore specific digital media topics related to the student's concentration.

5. *Technical proficiency*. Students need adequate "craft" skills and knowledge before moving on to advanced courses. The analysis indicated a disparity of student technical skills and knowledge, which is problematic when students enter advanced courses.

Ideate: Establish a technical proficiency course that is designed by the faculty. The aims are to: 1) help students to become technically proficient in software (and hardware) operations; 2) normalize technical proficiency across all students; 3) potentially allow for increased class time (in all classes) to be devoted to higher-order learning about digital media theory, research and design – rather than software and hardware operation.

6. *Examine the current knowledge base*. The analysis highlighted that faculty members have diverse skills, training, and knowledge as well as different perceptions about digital media and the DMA program. While the diversity is valuable, the program must prepare students with a core foundation in digital media, design and development.

Ideate: Faculty must examine, articulate (to all faculty), and assimilate throughout the curriculum a base of concepts, theories, methods, literature, organizations, authors, innovators, etc. that serve as foundational knowledge in all courses (e.g., in other words, when students graduate, they must all be familiar with these authors, innovators, theories, methods, literature, standards, etc.).

7. *Program Evaluation*. There is a need for the DMA program to be evaluated every 3-7 years and core courses to be evaluated yearly.

Ideate: Yearly: Faculty should meet to identify, review, and when necessary, revise competencies, goals, objectives, syllabi for each of the core courses. Every three to seven years: The entire curriculum and program should be examined on an ongoing basis at least every three to seven years. With the advisory board, establish measures and approaches by which to evaluate the curriculum and the program.

In this stage, the team created representations for a subset of ideas. Based on the work in the previous stages, the team proposed to rename the concentrations and to build multiple representations of the curriculum to test with the entire faculty and students. For the most part, these representations were formed around conceptual aspects. Processes and logistical issues were to be hopefully better identified in the testing phase, as constraints in this stage were prohibitive.

Testing.

- Yearly: Faculty should meet to identify, review, and when necessary, revise competencies, goals, objectives, syllabi for each of the core courses.
- Every three years: The entire curriculum and program should be examined on an ongoing basis at least every three years. With the advisory board, we must establish measures and approaches by which to evaluate the curriculum and the program.

Possible approaches:

- Survey, collect feedback from graduates, students and parents
- Affiliations with industry and professional organizations – interview affiliates in the industry to ascertain trends and directions of the industry
- Compliance with Standards from the National Association of Schools of Art and Design Association of Computing Machinery
- Industry (advisory board) assessment of curriculum
- Identify innovations, startups, products created by students/graduates. Collaborate with regional businesses and organizations and educational institutions on design, technology, digital "new" media related projects. For example, industries and organizations in the region face pressing design-oriented problems for which they may lack resources or time to investigate or solve. These design-related problems are diverse and cross disciplinary.

Possible measures:

- Enrollment
- Number of new collaborations or relationships with industry
- Success of recent graduates (student accomplishments/innovations/startups, jobs, etc.)
- Faculty accomplishment (e.g., documentary awards, research, etc.)
- Student assessments or comments on instructors, courses, or curriculum.

Discussion

Adapting Design Thinking Processes

Figure 1 illustrates an adaptation of the DT framework. The team proceeded through each of design stage, a highly iterative process represented by the double-arrows throughout the figure. Because of its practice-based applied nature, the DMA program and ultimately the design existed in and needed to accommodate a dynamic and technologically innovative context or "reality". For the program to be viable, it had to be responsive to the influences imposed on it by this context. External (e.g., changing technology, work processes, industry culture, innovations, etc.) as well as internal (e.g., departmental, college, university demands, etc.) factors exert continual influence on the program. The Influencing and Learning arrow in the upper left of figure 1 denotes how external sources serve as input or impose pressure and influence and provide opportunity for learning and improvement, assuming a design team has time and resources to effectively engage them - to help learn about professional and industry practices and ultimately enhance the curriculum. The academic program potentially influences,

ideally in positive ways, external sources by preparing students to enter the profession, which is depicted by the Impacting or output arrow in figure 1.

Adapting the DT process, the team grouped individual stages into Reality and Artificial to distinguish between activities that a) facilitated engagement with "real-world" external influences or sources; and b) activities during which it had less engagement with external entities, but it formulated representations based on knowledge gained from them. The Reality group includes Empathize (renamed Strive to Understand) and Test. The Artificial group encompasses Define, Ideate and Prototype (renamed Form). In the Strive to Understand stage, members endeavored to understand the external "real" context or "reality" in which the program exists. The team used a variety of methods (e.g., interviews) to sample that reality to better understand it and to help formulate a program that adequately reflects it. This stage engaged the team in a real way with many external forces (e.g., industries, competing academic programs, etc.) that influence the program. In the Testing stage too, members engage with students who ultimately graduate and in turn potentially impact external sources. However, moving from Strive to Understand to the next three stages (Define, Ideate and Form), the team participated less with external entities, primarily because of limited time and human resources. In these stages (Define, Ideate and Form), members formulated representations (i.e., Artificial) based on what was understood from data collected in the Strive to Understand stage. In other words, the meanings, ideas, and prototypes created in Define, Ideate, and Form derived from information gather in Strive to Understand. At least initially, those representations were based on limited iteration and little or no input from external sources. As a result, an advisory board was formed to ensure design efforts aligned with external sources. In Figure 1, Representations-External Sources is included to denote the importance of aligning with external entities, as the team witnessed a general tendency to work less with external sources in these stages. Correspondingly, while members engaged less with external sources during Define, Ideate and Form, they observed increased attention on internal factors such as department issues, and instructor issues with courses. As show in Figure 2, the design team tended to focus on external influences during Strive to Understand and Test stages (Reality) and internal factors during Define, Ideate and Form (Artificial).

Two labels of the DT stages, Empathize and Prototype, did not fully reflect the scope of the design activities. The phrase Strive to Understand more so than Empathize captured the essence of the work at this stage. In many ways, team members were trying to understand the context and their own motives, as well as the factors that influence the program – rather than trying to empathize with a client, for example. When interviewing a person, the aim was not to glean information from the interviewee to design a solution to improve their life but rather the interviewee provided information to improve the academic program. Additionally, "strive" suggests ongoing processes. Through research, the team recognized the potential value of continual engagement with external influences, specifically professional industries, and how despite best efforts it can only obtain a sampling of their reality – and this heightened the need for further continuing engagement with such external entities.

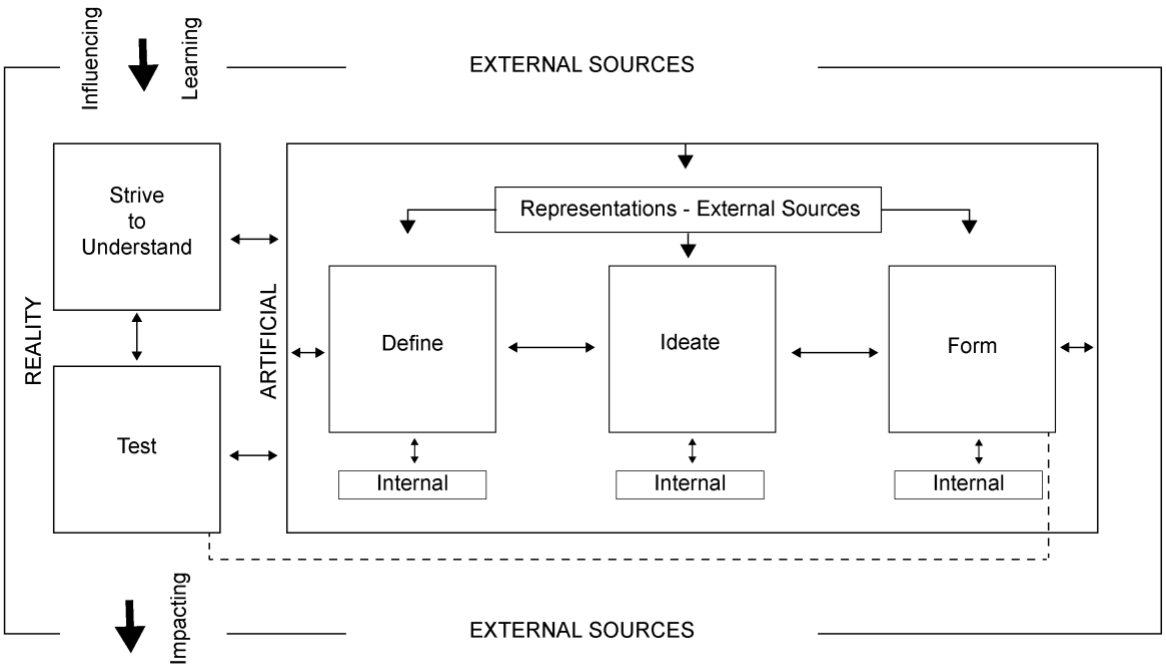

Figure 1: Adapted Design Thinking Process

Form rather than Prototype captured the essence of work at this stage. The nature of the design (a curriculum re-design) made it difficult to iterate designs in a sufficiently "real" context to reveal flaws or shortcomings. For instance, sharing prototype designs with users, yielded feedback largely focused on conceptual aspects (e.g., course topics and titles) versus process issues (e.g., course sequences, topic progressions). Moreover, curriculum changes often cause rippling effects on logistical and other unforeseen educational dimensions that could not be adequately identified. In terms of prototyping, an iterative process of design and user-testing that moves successively to more refined, higher fidelity close-to-finished products was largely true for conceptual facets but not so for process and logistical factors. Therefore, this stage consisted of forming conceptual representations of designs that, given the constrains, could only be evaluated during the Test stage. In Figure 3 there is direct connection between Form and Test, denoted by the dashed line, to indicate that these types of prototypes may require a higher degree of refinement or fidelity only achievable during the Test stage. Prototyping scenarios that afford a level of fidelity and rigor characteristic of traditional prototyping prior to the Test stage may be possible, but constraints proved prohibitive for this project.

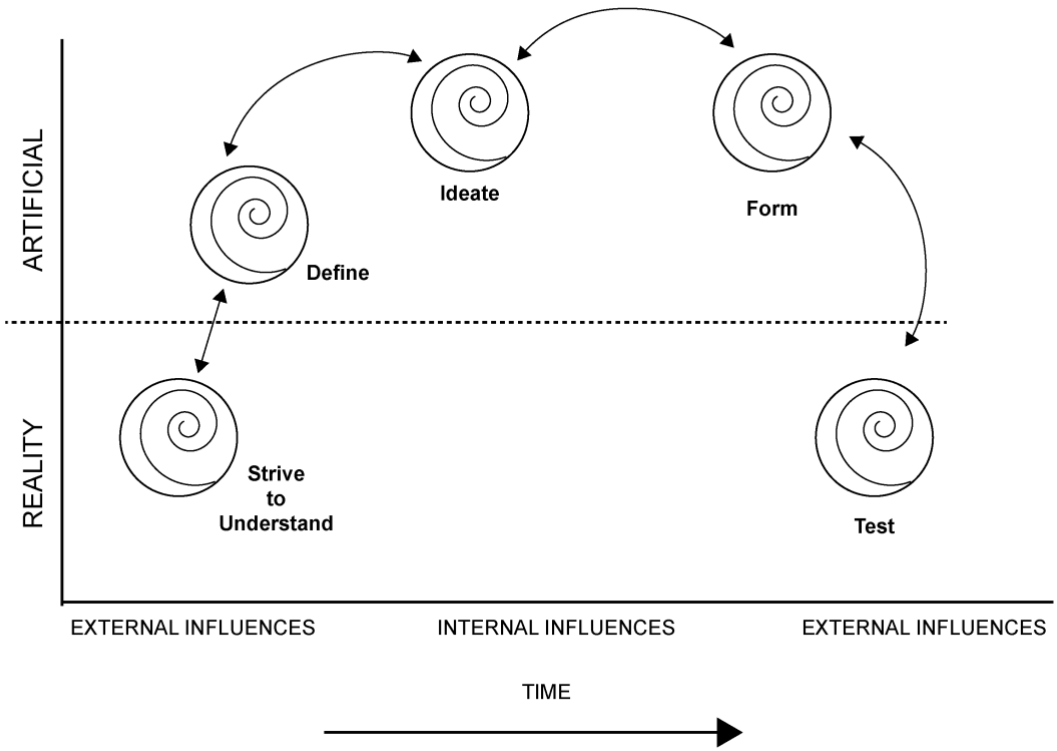

Figure 2: Design Thinking and Influences

Benefits and obstacles to using DT were observed.

Benefits

Given the unique challenges faced by digital media and technology-oriented programs, DT was a useful framework, particularly for non-designers, to structure program and curriculum assessment and re-design. It offered a frame of reference getting started. The program and curriculum work were multifaceted.

DT afforded a systemic view of problems. Iterations help engender thinking beyond the immediate team to external and internal sources to gain important insight about the feasibility of ideas and how they impact and would be impacted by the larger department and professionally community. It allowed the teams to understand the various epistemological frameworks that not only exited in the departments but also in the professional community. Initially, the team did not regard the professionally community (or members of) and the entire faculty as being part of the design team or one of its audiences, mainly to be sensitive to their time needs, which limited the perspective. Questions arose about who this work impacted and about our audiences, which eventually caused the team to be more inclusive.

Obstacles

It takes much time and work. Assessment and re-design are time consuming. Faculty members' time is limited by teaching, research and service and so their ability to engage in design activities is constrained. Introducing iteration throughout the DT process was unfamiliar to participants and, in some cases, they wanted to move on quickly after initial work was done.

There was also a tendency to be satisfied with initial findings and to stop further iteration or refinement.

It can be easy to overlook the impact of internal factors on design. It takes time for faculty to assimilate to a re-design of this type. The classroom environment is a uniquely individual experience for faculty, particularly those who excel at engendering connections with students. Pedagogical approaches, techniques to engage learners, imparting the classroom and departmental cultural, edifying the language of the discipline, among other things, are perfected over years of experience. A re-design of this type not only alters a curriculum structure, it re-forms the departmental cultural and classroom dynamics, the potential of which can be disorienting to faculty – and not readily apparent during the design process. Superficially applying a DT framework to a design is not likely to highlight such issues. At times the design team became excited about proposed changes, but it was important to ensure that those changes did not appear threatening to faculty. For instance, studio-based courses were proposed. For a faculty member who has taught successfully for years using lecture, demonstration, and discussion, restructuring a course to studio format can seem daunting. This is particularly germane for tenure-track faculty who might be concerned that making course format changes will impede student evaluations and their chances for tenure. It is important that all faculty, to the extent possible, partake in the design process – that they have input at each stage of the process so that they may take ownership of the design.

Terms such as empathy, iteration, and ideation helped to frame discussions and the overall work. At the same time, as team members learned about DT and its terms, the framework in its original form seemed highly suited for design problems in which a designer provides a design solution for an external client, where the solution directly benefits the client and not the designer. Conversely, as use here, the team served as designer and client and so the framework was modified somewhat (see figure 1).

Tools

DT provided a useful context in which to conduct the curriculum design. Tools that facilitate examining curricula are important components to design. Willness and Bruni-Bossio (2017) provide a useful framework, the Curriculum Innovation Canvas, that provides a logical structure to foster a creative and fluid approach to curriculum design. Major components include Stakeholder Groups, Stakeholder Relationships, Value Propositions, Activities, Resources, Constraints, Communications processes, Design-Content and Outcomes-Impact. Within each component, there are "…guiding questions to help the user identify and articulate their own content for each area." (p. 148). The authors note that the Canvas can be applied to a course, project, or entire curriculum. Designer may use Canvas to formulate curriculum ideas and examine them in unique ways.

Based on its work on the DMA curriculum, the design team adopted Canvas to use for future curriculum innovation (see Table 6). Major components in our adaptation are External Stakeholders, Internal Stakeholders, Proposed Value, Activities, Resources, Limits, Synergy, Content, and Outcomes. Because external factors have much impact on our curriculum, we included components for external and internal stakeholders. Stakeholder is a broad term that conveys the relationship of any person or entity engaged with or affected by the course or program (Willness & Bruni-Bossio, 2017). External stakeholders may be individuals at company,

organizations or associations in the community. Internal stakeholders may be faculty, administrators, departments within the university.

Our adoption of Canvas includes a prompt for definitions to clarify the language in describing courses and course concepts. Clarity about terminology helps reduce ambiguity, which is especially important for academic areas such as digital media where terms engender diverse meanings. In addition, based on data collected from interviews, we added prompts to reflect the scope (to include all personnel), existing standards (i.e., academic standard ACM), planning for change and preparation for future successors of the course or program. Moreover, the Curriculum Innovation Canvas includes components for activities, constraints, and resources. We present prompts for activities, limitations, and resources in all major and minor components of the framework. For example, when thinking about external stakeholder relations, we wanted to provide prompts related to: a) the activities involved in establishing those relationships, b) limitations to achieving them, and c) resources needed to achieve them. At the same time, we thought it was useful to include these prompts - activities, limitations, and resources - in value statements, course content, and outcomes components. We used the term Limitations rather than Constraint to focus on factors that might restrict the realization of a component.

In the context of the DMA curriculum, we envision our adoption of Canvas could help us foster reflection about establishing relationships with stakeholders, particularly external stakeholders, and maintaining synergy across stakeholders, courses, content, and learning outcomes. We think it could be used to help DMA, which is greatly influenced by external-professional forces (e.g., industry, technology innovation). Additionally, we could envision an electronic version of the framework that integrates Skills and knowledge data from Table 4, which would allow us to examine curriculum data in unique and diverse ways to gain greater insights and to aid in decision making.

Table 6. Adaption of Curriculum Innovation Canvas (Willness & Bruni-Bossio, 2017) to DMA Curriculum Design

Definitions
Define titles, descriptions used to describe course. Describe context in which language is used.
Is language relevant to social-cultural factors of program and larger professional community.
Scope, Standards, Change, Future
What is the scope of faculty, administrator and stakeholder involvement?
Are existing curriculum standards available? If so, what are they?
How will proposed course adapt to future changes-innovations? How can it be sustained?
How is course ready for future and those who will inherit it?
External Stakeholders
Define potential stakeholder who may be consulted.
Describe context (e.g., industry) in which stakeholder exist.
Describe how stakeholder can be involved (e.g., project-based learning, consultation, internships, service)?
Why is stakeholder important to course and program?
Describe stakeholder's value or potential influence on program.
Describe benefits associated with establishing relationship that may advance student theoretical, methodological or technological understanding.
What activities must occur to established and maintained relationship? Who is responsible?

Describe resources (e.g., personnel, time, financial) needed to facilitate relationship.
What are limits on relationship (e.g., time, resources)?
Internal Stakeholders
Who should be consulted?
Describe context (e.g., faculty, administrator) in which stakeholder exist.
Describe stakeholder's relevance to course and program.
What activities must occur to established and maintained relationship? Who is responsible?
Describe resources (e.g., personnel, time, financial) needed to facilitate relationship.
What are limits on this relationship (e.g., time, resources)?
Synergy
Describe how synergy might be maintained among stakeholders, proposed course, and program.
What feedback and communications mechanism must be established?
What activities must occur for synergy to exist? Who is responsible?
Describe resources (e.g., personnel, time, financial) needed to facilitate synergy.
What limits synergy?
Proposed Value Statements
What value does the course add?
What value does course add to: students, program, internal and external stakeholder
Activities
Describe activities that must occur to fulfill the proposed value statement? Who is responsible (e.g., students, internal stakeholders, external stakeholders)?
Describe resources (e.g., personnel, time, financial) needed to facilitate value statement.
What are limits on this activity (e.g., time, resources) to fulfilling value statement?
Content
Major course topics and how they align with value statement(s).
How are major course topics associated and aligned with internal and external stakeholders?
Describe course activities aimed to fulfill each value statement.
Describe resources needed to facilitate course topics.
Are there limits related to executing the course topic (e.g., time, resources)?
Outcomes
What are desired student learning outcomes? What indicators provide evidence? How will you measure success?
What are desired outcomes for program, internal and external stakeholders?
Describe activities that must occur to fulfill outcomes.
Describe resources needed to facilitate outcomes.
Are there limits related to fulfilling outcomes?

Summary

Academic programs in digital media face unique challenges. Digitization and corresponding digitalization, while spurring innovation and emergent technologies, disrupt business and educational institutions as they must continually adapt to rapid innovation to keep pace. These forces instigate a new order of challenges, often highly complex and ill-defined. As used in this project, a DT framework can provide, with modification, a ready and easily interpreted framework for non-designers to structure and guide curriculum design.

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