SYNOPSIS OF THE 2020 FORECAST:
CREATING THE FUTURE OF LEARNING

This is a summary of work by the Knowledgeworks Foundation and the Institute for the Future on the Future of Learning. The more complete report appears on the website at: http://futureofed.org. The 2020 Forecast illuminates how we are shifting toward a culture of creation in which each of us has the opportunity – and the responsibility – to make our collective future. People are creating new selves, organizations, systems, societies, economies, and knowledge.

THE FUTURE OF KNOWLEDGE / DRIVERS OF CHANGE

- **Amplified organization: Extended human capacity remakes the organization**

Digital natives and technologies of cooperation are combining to create a generation of amplified individuals. These organizational "superheroes" will remake organizational models through their highly social, collective, improvisational practices and their augmented human capacities. These new models will thrive in a world of social networks; information proliferation, transparency, and saturation; and rapid change. As digital natives enter learning professions, and as existing educators and students become amplified, their extended human capacities will challenge traditional ways of organizing learning and will amplify schools, districts, and other learning organizations.

TRENDS

- Effective communication depends on the ability to read, write, and interact across multiple media and social platforms.
- Open collaborative platforms enable networked teams to self-organize and support ad hoc leaders.
- Transparency, collaboration, and rapid iteration create a beta culture displaying open critique and reflective practice.
- Diverse and abundant data streams increase the need for organizations to tap collective intelligence.

- **Platforms for resilience: Creating flexibility and resilience among system failures**

System shocks and disruptions in the arenas of energy, finance, climate, and health care are key forces of destabilization in this century. Institutional strategies that focus on resisting disruption and maintaining the status quo will not offer sufficient responses. Platforms for resilience - enabling responsive flexibility, distributed collaboration, and transparency - will allow institutions to meet such challenges through innovation, adaptation, and openness. As key points of convergence for health, learning, and environment, school communities will need to develop strategies for building resilience into their systems and for creating lightweight, modular infrastructures that can support the health and wellbeing of learners, families, and learning agents.

TRENDS

- Brittle hierarchies will continue to act in ways that seem institutionally rational but which further destabilize weak, inflexible systems.
- Smart networking, data transparency, and bottom-up monitoring enable responsive, open decision-making.
- Smart-networked resource providers and learning agents create lightweight, modular learning infrastructures.
- Super-empowered, networked learning agents leverage the growing learning economy to enable provisional learning systems.

- **New civic discourse: Rearticulating identity and community in a global society**

The convergence of participatory media culture, diverse diasporic movements (the formation of dispersed populations that share common roots and identity), and frameworks for creating new commons (bottom-up means of managing shared resources) set the stage for re-articulating identity and community in a global society. Education will find itself a contested resource in the crossroads of these forces of change. It will become part of the civic discourse in multiple new kinds of public forums and spaces as "educitizens" make visible the status of schools and of educational decision-making, resources, and activities in their communities. School administrators, district level staff, and teachers will need to learn how to communicate and interact in a bottom-up world of engaged educitizens.

TRENDS:

- Educational stakeholders grow collective learning resources, creating an alternative to public and private schools.
- Students and families affiliate around educational needs and claim rights as learners.
- Participatory media and digital natives bring transparency and collective action to the civic sphere.
- Diverse movements of people create new identities and flows of learners.
- Families look outside the traditional "system" to create ecologies of learning experiences.

- **The maker economy: Personal fabrication technologies and open source principles democratize production and design**

New forms of bottom-up social networking and economic coordination, along with advances in small-scale, community-based fabrication and design, transform local economies in the next decade, enabling productive flexibility that will help cushion against economic instability. New tools, including 3D printers (desktop printers that print out objects, parts, and components), computercontrolled machine tools (such as laser cutters), and online networking applications (that allow designers, consumers, tinkerers, and artisans to share blueprints, solutions, and how-to knowledge) will enable local communities to "make" their own economic futures - to innovate, customize, design, and create solutions to meet local needs. Schools, community centers, and local businesses will become important hubs of design knowledge, rapid prototyping, and problem-solving skills that will increase local interdependencies and resilience, redefining relationships with the broader economy.

TRENDS

- Ad hoc factories and job shops enable flexible, fast, and customized production.
- Solo inventors, tinkerers, and craftsmen form networks to collaborate and celebrate their creations.
- Better desktop tools, 3D printers, and digital machinery democratize the machine shop.
- Makers reach out to their markets and communities to ideate, iterate, and solicit feedback. Research and development is no longer relegated to a lab where only "experts" are welcome.

- **Pattern recognition: An extremely visible world requires new sensemaking**

Information proliferation will continue, exacerbating the burden on families, learners, educators, and decision-makers to make sense of vast amounts of data. New tools for visualizing data will require new skills in discerning meaningful patterns. Social media and collaborative tools will leave "data trails" of people's online interactions – including contributions to group activities, inquiries and searches, skills, digital resources, and preferences (such as playlists, buddy lists, and topics tracked) – and social networks. At the same time, sensors and global positioning systems in devices such as cell phones and car navigation systems will be able to capture location-based information along with health and environmental data. Together these tools will provide a robust, visible "data picture" of our lives as citizens, workers, and learners. Families, learners, educators, and decision-makers will need to become sophisticated at pattern recognition in order to create effective and differentiated learning experiences and environments. Furthermore, new skills in collective sensemaking will redefine forms of knowledge, knowing, and assessment.

TRENDS

- Personal data trails about preferences, attributes, and performance shape an evidence-based culture.
- Vast data streams require visual tools to discern underlying stories.
- Data trails, participatory media, and visual tools create new bases for reputation, mastery, and recognition.
- Gaming platforms become critical training areas for work, problem-solving, and learning.
- Blended physical-digital worlds create new learning geographies. Learning in the real world is complemented by the navigation of virtual worlds through avatars.

- **Altered bodies: Experimenting at the intersection of environment and performance**

Advances in neuroscience are revealing new understanding of the brain, its plasticity, and its responsiveness to the environment. Emerging notions of neuro-diversity and physical "disability" will challenge standards of what is "normal" and will spark innovations that help mainstream populations. At the same time, greater threats to human and environmental health from climate change, pollution, war, extreme urbanization, and other natural and human-made disasters will in the next decade create new stresses on minds and bodies. These stresses will converge in schools, some of which will seek to instill a sense of stewardship for self and environment in their students. With their mission to educate all students, these schools will become key sites for interventions to overcome the various challenges of disability and bio-distress and their impacts on learning.

TRENDS

- The brain becomes a site for alteration and maintenance. An array of services, products, and programs has already hit the market.
- Neurodiversity, physical enhancements, and disability communities converge, turning marginalized populations into mainstream innovators.
- Eco-schools become a nexus for health, environment, community, and learning.
- Threats to our biological, ecological, and built environments drain resources and demand coordinated responses.

TEACHING LARGER STUDIOS

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Today there are financial pressures within colleges and universities that threaten the traditional practices of design education, among them the small class size dedicated to studio instruction. While in fatter times it was easy to justify 15-16 students meeting with a professor for many hours per week as integral to successful professional education, the current economic climate challenges assumptions about what is essential for effective instruction, especially in multipurpose universities where typical class sizes in other disciplines are much larger.

Faced with declining budgets and increasing demand for design instruction, the Department of Graphic Design and Industrial Design launched an experiment in fall 2009 to see how critical class size is to learning in design. We enrolled 29 first-semester juniors (twice the typical population) in a single graphic design studio under the shared instruction of two faculty, Meredith Davis and Santiago Piedrafita, who each held three-credit faculty assignments in the six-credit course. On some days both faculty were in the studio, on other days faculty worked alone. The class met twice a week, Tuesdays and Thursdays, for 4.5 hours each day in a dedicated studio space where students used their privately-owned computers and software. Students entered the course having completed 32 credits in pre-requisite studio instruction and were registered concurrently in 3-credit courses in typography, imaging, and design history. Other than class size, all factors were the same as in previous semesters when there were two, 15-student sections of the same course under two faculty, each with a 6-credit teaching responsibility.

The objectives of the course called for students' first experiences in branding, interaction design, and service design as expressions of systems design. The required studio is the third in a sequence of required studios on systems and is a transition to upper-level topical studios in which students take on increasing responsibility for self-defined work, culminating in a last-semester capstone project.

We began the semester by agreeing on several premises underpinning our instruction. We shared these premises with the students:

1 **No individual desk critiques.** With 29 students in the class, it would not be possible to visit each student's desk for a personal review and substative critique of work within any given class period. Although this is a longstanding tradition in design education, we believe that the "desk crit" practice engages the student intellectually only while the faculty member is at his/her desk. In a 15-student class, the use of this practice typically means 10-15 minutes of real interaction between an individual student and a faculty member during a 4-hour class. Students spend the remainder of time in activities that could have been done at home and receive no benefit from faculty comments made to peers. In many cases, the same counseling that moves an individual student project forward could be accomplished in a brief meeting during faculty office hours with students who need such consultation.

2 **No large group critiques of individual projects.** Another traditional practice, this approach to evaluation often results in disengaged students who pay attention only when the instructor and class speak about on their own work. While there are alternate formats for the all-class critique – such as break-

ing students into smaller groups for discussion that is then reported back to the larger group –critiques usually go on and on without easy resolution that informs a student's next move and many students can not retain the content of the critique delivered under public scrutiny. In an upper-level project, there may be several of these critiques across the span of the project, sapping the energy from the discussion of too-familiar work at the end of the project. And the more prescriptive the assignment, the less there is to say about what distinguishes one student solution from another. In general, students "tune out," losing much of the perceived benefit that might come from discussing a peer's work.

3 **Good experiences with group work.** Typically, college students dread group projects. Their prior experiences tell them that they must either disengage from a contentious team or carry the majority of the workload to compensate for less productive classmates. The sense of personal ownership of work, fostered in beginning classes with a fine arts perspective, argues against later shared work in design and the stakes in group projects are often so high (i.e. grades are assigned evenly across the group) that no one wants to step forward to assume leadership for fear of being held responsible for classmates' academic success or failure. And faculty frequently tout the importance of teamwork but rarely provide any instruction in how to do it, so students are left to resolve complex social interactions among designers while also learning about the content of the project.

4 **Not every student will be doing the same thing at the same time.** The overriding practice in most design studios is that there is a common assignment and the project brief suggests appropriate methods and implies criteria for the evaluation of student solutions. In this sense, all student work is undertaken simultaneously in very similar activities and student-to-student learning is about how each member of the class tackled the same problem. In order to achieve this symmetry, faculty must frame the problem. This gives students little experience in identifying the scope and depth of investigations, let alone the criteria for success, when in fact, demand for that very skill that is likely to endure across students' professional careers.

5 **Just-in-time lectures.** Lectures in studio-based design classes typically occur at the front end of assignments, set the conditions for the project, and address issues common to all students. Although technical instruction may occur as needed throughout the project, rarely is method or perspective released periodically throughout the course of the project. When it is, there is an assumption that all students are working on the same kind of task or stage of the problem; there is little diversification of lecture content because faculty, not students, usually set the problem parameters and prefer little deviation from a general description of student activity.

The set-up of the room:

The 29 students were located in two studio spaces with a common door. We created a team discussion area between the two rooms in which faculty met with small groups or in which collaborative work could take place. Individual workstations were grouped according the first, warm-up project assignments and students remained in these pods throughout the semester, even when not working directly with the students in their pods. This arrangement created a lot of movement in the room, allowing students to see work as it was being produced. By the end of the semester, it was not unusual to see three students in the common space, laptops side-by-side, negotiating visual elements across three project components or working collaboratively on the same document. In fall 2009, the H1N1 flu virus hit this group and 10 students were home-bound for as much as 10 days in compliance with university health regulations. Without faculty intervention, they continued to participate with their groups, skyping in to lectures, student group meetings, and non-class work sessions.

The warm-up project:

Given the overarching premises for classroom management, we first assigned students a short warm-up project that grouped them under six topics with responsibility for individual solutions that related to the topic. The project focus was on social behaviors, not on subject matter. Students suggested the design of systems that addressed the issues of: customizing; bartering; searching; curating; wayfinding; and doing-it-yourself. On some days students met in groups of five around the topic and other days in different groups of five based on similar formats or methods for explaining and demonstrating the behavior.

In this sense, group work was low-risk (it concerned the research and analyss aspects of the problem) and there was no "group fatigue" because participants in discussion groups changed in each class period. No student could disengage because he/she was in a small group with a faculty member for about 45 minutes of very focused time on a topic immediately relevant to his/her own work. Dividing faculty responsibility for lectures, we addressed examples of the project content in professional solutions to similar problems; discussed the interactive affordances of various formats (posters versus web, for example); and offered methods for working (storyboards versus concept maps, for example). All students observed the breadth of content in lectures but engaged in specific project work and small group discussions, This strategy got the students comfortable working in groups while maintaining independent project responsibility.

The critique for the warm-up project departed from the traditional studio format. Each student group was asked to produce a 5-minute pdf slide show summarizing 3-5 key learning outcomes from the project, using their work only to illustrate the learning outcomes. This approach asked them to "construct an argument," with all the related issues of presentation logic and how best to illustrate work produced in another format. They had a dry run in which the faculty critiqued the six presentations, using each to make a different specific point about the design of presentations. Two days later, all issues had been addressed in their final presentations. The conversations in this critique, therefore, were not about descriptions of each project but about what important ideas could move forward into the next project and how those ideas were represented.

At the same time, all of the individual physical artifacts were displayed in the common area. By their own choice, students spent 90 minutes in informal conversation with their classmates about the work. In other words, without structuring a formal critique, students still engaged in critical evaluation and interaction with their peers; they did so with full engagement in the process, which was less likely when faculty were in charge. This was a pattern we maintained throughout the semester and student interaction never waned.

Speed dating:

In preparation for the larger semester project, we set up a "café of small tables" and assigned students to groups of three for brainstorming sessions. Students moved to a new group every 15 minutes for a total of three brainstorming sessions and were scrambled according to the topics of their assignments in the warm-up project. Their task was to come up with organizations, projects, or companies that could provide services related to the six topical areas. The class generated 60 ideas in 45 minutes and posted them on a facebook site (their idea); over the following weekend they chatted about personal interests, renegotiated the scope of each problem, and grouped themselves into six 3-person teams by the following Monday. In other words, after the speed dating activity, 29 students managed the assignment of people to content and collaborators, as well as the articulation of a problem statement, without faculty intervention. Because content had been generated collectively before the teams were chosen, students gravitated to interests rather than to personalities; the larger decision of "what to do" that frequently causes disagreement within teams had been determined before they decided to work together.

The remainder of the semester

The remainder of the semester was spent with ten teams of students working on the design of interaction, service, and branding for their organizations. While one student had individual responsibility for one of the functions, none could work without the coordination of the group. The lectures from the warm-up project were expanded and faculty led students through a series of activities designed to "build a project" (for example, developing robust problem statements, mapping relationships among components within the system, charting user touchpoints, curating related examples from professional practice, proposing prototypical components for development, etc.). Faculty focus was on meta-content, while students determined the details of their own projects. Faculty continued to meet with students in small groups, sometimes within assigned groups and other times within functional assignment groups (interaction, service, etc.). Posting work daily was one of the students' responsibilities and spawned informal critiques that were driven by common concerns within a group, not by arbitary deadlines.

In the end, students were responsible for producing a single document of the project, including photography of their individual project components and analysis of the project building process. While the pdf slide show in the warm-up project was a presentation "for when the designer is there", the booklet was intended to substitute for the designer when he/she is "not present." In this way, the deliverable matched demands in practice.

What we learned

The positive outcomes of the experiment encouraged us to repeat the strategy this semester:

- **There was no difference in the visual quality of work produced in a 15- versus 29-student class** and considerable improvement in the mastery of concepts that are transferrable to other situations; less faculty time was spent in individual "art direction" and more time spent on concepts and strategies through which students can make judgments about form.

- **Students reported that they much preferred the format of small discussion groups to desk crits and summary presentations of project outcomes to all-class critiques of individual work**. Their ability to situate the outcomes of their learning within larger contexts improved under the new conditions and they maintained momentum throughout the project. In cases where specific comments were made about one group's project, revisions in all groups' work showed attention to the same details. This illustrated to us that if the critique format maintains students' attention to the discussion, issues need only be mentioned once, not with every individual project.

- **Greater student autonomy resulted in richer interactions between students and faculty**. Less time was spent by faculty in making general comments to the class on a single project and more time spent in addressing particular issues that small groups of students had in common. In mid-term evaluation appointments, students frequently commented on the accuracy of faculty knowledge of them as individual problem solvers, so there was no evidence that this classroom management strategy or larger enrollment decreased faculty knowledge of students' abilities.

- **Careful management and instruction in group work resulted in no group meltdowns and students, in their mid-residency reviews at the end of the semester, credited the class with changing their perceptions of collaborative projects.**

- **Faculty moved from an authoritarian to a facilitation role and students gained greater experience in framing investigations and managing work**. By frontloading the class with an explicit structure for building project-based investigations and just-in-time lectures that delivered specific content when students were ready to make choices among options, faculty developed in students a working pattern that was sustainable within a large group without continuing faculty management. The shared teaching assignment expanded the available faculty expertise for the development of these lectures. In faculty time, therefore, it cost less to teach the one larger class than it did to teach two sections of lower enrollments – 6 credits of faculty time were open for reassignment.

In general, therefore, we reached the conclusion that class size has less much effect on student learning than we previously thought. We suspect that this strategy is more likely to be successful with upper-level undergraduates who have basic skills in place, than with beginning students, but it does open options for more flexible scheduling and more efficient enrollment and staffing patterns in the program.

EXTENDING FACULTY RESOURCES

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With the fast pace at which communication technologies emerge and obsolesce, we find ourselves in a precarious position. On one hand, our students should learn (how to learn) various software packages in order to fulfill basic skill requirements within the discipline. On the other hand, students should also learn strategies and principles necessary to approach projects with purpose and appropriate form throughout their careers. Merely teaching the software or strategy alone has equally limiting ramifications. While only knowing the software spurs de-contextualized form generation, knowing only strategy frustrates students in their inability to actualize well-envisioned systems. The upper level undergraduate special topics course, *Design for Mobile Interaction*, synthesized strategy and technical skill development through the process of a semester-long project and extended the teaching resources of the program through teleconferencing with industry specialists.

"Design for Mobile Interaction" was developed as a special topics class for the North Carolina State University undergraduate curriculum in graphic design. Before entering the special topics course, students had preliminary experience with interactive software and fundamental knowledge of concept mapping. In a prerequisite course, they prototyped an interactive system, which incorporated various touchpoints—a website, mobile app, large touch screen, and physical space. However, the prerequisite course focused on information flows among touchpoints rather than one touchpoint exclusively. As an appropriate progression within the curriculum, *Design for Mobile Interaction* challenged students to refine their conception of mobile design within a service ecology.

Before going any further, I want to disclose the fact that I am not an industry expert in mobile interaction design. The conception of this course occurred while visiting a friend, Prarthana Panchal, who works for the T-Mobile !Creation Center (!CC) in Seattle. She invited me into the studio to meet everyone and within a few minutes it became clear that their process aligned with the design process taught at NC State. Over the next few days, the !CC team shared their perspective on mobile interaction and I shared my research interests with them. In casual conversation, we discussed ways in which the !CC team could work directly with students on a project. We collectively agreed to keep the door open for a future collaborative opportunity.

When asked by our department to propose a special topics course, mobile interaction was at the top of my list. Not only did it fit well with the prerequisite course and overall curriculum, I knew experts who wanted to participate in the classroom. I contacted Prarthana with a draft of the syllabus and asked if she would like to present to the class through video chat. She and the !CC team jumped at the opportunity. Not only did they want to share behind the scenes information as I originally planned, each team member wanted to deliver a presentation specific to their role at the !CC. We worked out the logistics through email and video chat. By the beginning of the semester, we had four T-Mobile presentations scheduled as well as a larger T-Mobile group interested in participating in the final critique. The !CC team brought credibility to the methods and subtle nuances to critiques. Their involvement made an interaction and/or experience design career a tangible possibility for the students. Consequently, half the students sought out summer internships designing mobile interaction.

In addition to developing the syllabus and securing industry expert involvement, I created a course website to host weekly student progress and reference material for mobile interaction. The website enabled T-Mobile to track and comment on the students' work. In class, it facilitated "silent crits" in which students wrote detailed feedback on each other's work. Students also wrote comments during presentations as a way of collecting their thoughts before discussing the work as a group. When figuring out how to move forward, students easily accessed previous iterations and feedback.

In addition to posting progress, students also contributed at least three case studies, articles, and how-to's, which at times raised heated debates in class. The responsibility of providing how-to instruction encouraged students to find and share online software and coding resources as extensions of class demonstrations. It also gave students the opportunity to show off tricks they used in their projects. As a whole, the website revealed overarching patterns in the students' work. I could address recurring issues, not by telling the students what I observed, but by dynamically comparing and contrasting work in a way that encouraged the students to recognize patterns for themselves. The course website was an essential hub for coordinating, tracking, and analyzing work throughout the semester.

For the duration of the semester, students designed a mobile component for a service of their choosing. The service was to:

- Enable a specific group of people to learn a complex process;
- Foster skill development, rather than information management;
- Clarify what and why a person should perform a specific set of behaviors; and,
- Offer a temporary learning environment—the person should not rely or depend on the service for an extended period of time.

Students chose processes such as young adults learning about the stock market, early teens learning energy conservation practices, high school biology students learning symbiosis, travelers learning to speak Spanish, young adults learning to cook from scratch, adolescents learning to play the cello, and new home owners learning home repair.

We began the semester by describing and analyzing the affordances of mobile interaction. Student-generated taxonomies divided interaction into three categories: cognitive influence (affects what you think and how you do something), interactive capability (technical features in terms of user experience), and affective influence (affects feelings and beliefs about something). The taxonomies enabled students to identify strengths and interactive qualities specific to mobile interaction.

As the strengths and weaknesses of mobile interaction became clear, students nested mobility within a service model, illustrated in concept maps: The first map reflected the components of the complex process—the vocabulary and skills a person would need to learn. The second map identified the activities in which knowing the skill is useful. The third layer surveyed the existing ways in which people learn the complex process. After generating sketches in class, students found support material for each question and refined the maps accordingly. The service model positioned mobile interaction as part of a larger interactive system.

With a macro-perspective of the service mapped, students then drilled into the purpose, goals, and learning outcomes for the mobile component. Using Bloom's Taxonomy as a structural reference point, students declared the criteria on which they based and measured their design decisions. Framing criteria as learning outcomes also helped students focus on designing learning conditions, rather than management tools.

At this point in the process, the students were ready for the !CC lecture on context-assessment techniques. For all !CC presentations, we used two projection screens: one to project the video chat full screen and the other to project the presentation (which !CC controlled using acrobat.com). We could see the presenter and the presentation clearly, and the presenter could see us. After the presentations, students asked questions through video chat or through the course website. The questions generally related to clarifying a talking point or asking for suggestions related to the student's individual project needs.

Our first guest, Joyce Chou, Customer Innovations Producer at T-Mobile !CC, presented context-assessment techniques. She encouraged students to explore beyond the assumptions articulated in the service model—to find evidence to enrich or correct for the contexts deemed "appropriate" for mobile interaction. Rather than cover every technique she employs in her work, Joyce focused on techniques feasible for the students to use. She presented examples of interviewing people in their homes, and she shared tips on how to make people feel comfortable and open up during the interview.

After Joyce's presentation, students declared the context-assessment technique they would employ and their justification for using it. Some students interviewed experts on the chosen topic, while others filmed novices performing topic-specific tasks. Before moving on to the design of the mobile app interface, students formalized their efforts up to this point in a project proposal presentation. Goals and outcomes set the stage for the design plan. The project proposal presentation encouraged students to reflect upon significant leverage points within the service ecology and to commit to a course of action.

With a plan and criteria on which to base design decisions, the students began storyboarding scenarios of situations in which mobile interaction for the learning topic could occur. Jon Mann, Senior Design Manager, Strategic Innovations at T-Mobile !CC, presented storyboarding and scenario development techniques. Jon first explained the necessity of scenarios in collaborative work, such as illustrating the significance of the proposed design in ways necessary to gain project approval from business executives. Jon then transitioned into specific techniques for storyboarding convincing scenarios.

Following students' work on storyboarding, Prarthana Panchal, Senior Interaction Designer, Technical Innovations at T-Mobile !CC, presented techniques and tips for designing the information architecture—wireframes, click streams, interactive priority lists, and rough prototypes. Unable to share actual project materials for legal reasons, Prarthana mocked up versions of a faux project to illustrate her role in the T-Mobile team. She showed the degree of complexity at which she develops wireframes and gave examples of how she annotates click streams and interactive priorities on wireframes. Lastly, she demonstrated quick prototyping techniques, such as stacking and applying actual-size wireframe print outs to a mobile device.

Having already generated wireframes, students annotated click streams and priority lists on their projects. They created paper prototypes of the interactive interface through time. Those who had an iPhone or iPod Touch swiped through the wireframes on the screen using iPhoto. Again, students posted progress to the course website for feedback in respect to the outcome criteria.

Ric Ewing, Senior Interaction Designer at T-Mobile !CC, presented rapid prototyping and production methods for the last T-Mobile presentation. Ric explained the logistics of working with programmers, from key vocabulary to preparing interactive documents and prototypes for programmers. The realization that designers do not need to be expert programmers to bring their design to fruition relieved and invigorated the students. Instead, designers plan for interactive moments, develop graphic assets, and demonstrate the scalable characteristics and behaviors of the interface through an interactive prototype. Ric also discussed the significance of making interactive wireframes. Rapid prototyping, he argued, gets you closer to the real

thing early on in the process. Ric's and the other T-Mobile presenters helped students envision the scope and type of work designers for mobile interaction do, and the methods and techniques for doing it well.

By this point, the students had defined the nature of the mobile apps fairly well. I assessed the overarching technical needs of the class, and then developed a couple software demonstrations accordingly. The demonstrations integrated five programs within the Adobe Creative Suite, which revealed the strengths of each program and how to streamline the production process.

Students were both eager and nervous about the final presentation. Just as T-Mobile presented to us, the students presented their final presentation to T-Mobile and the class. During the presentations, students, visitors, and T-Mobile alike evaluated each project based on a digitized PDF form with evaluation criteria (see attached). After each presentation, we took a couple minutes to fill out the form, and then opened the floor to discussion. The T-Mobile team participated in the discussion just as much as the students in the room. In particular, T-Mobile raised feasibility issues and pointed to specific moments and techniques in the process that could repair inconsistencies in the final prototype.

In the end, the students learned to design for mobile interaction. More importantly, they learned a process for designing within interactive systems. They practiced a framework through which to develop criteria for making design decisions, learning how to critically analyze affordances of communication technology. They also learned to nest various formats within a service model, taking advantage of specific affordances and visualizing the service as a collection of various interactive moments. By visualizing the structure and patterns within complex systems, students made decisions based on the dynamic nature of interactive systems. Mapping, storyboarding, and prototyping iteratively throughout the process gave students something concrete and tangible to refine. The course revealed the roles design plays in mediating and fulfilling a larger purpose as well as opportunities to influence learning experiences, for the better.

As a whole, inviting industry experts into the classroom, working through the a series of methods throughout the process of one project, developing technical demonstrations to suit collective project needs, and utilizing a course website as a critique space proved an efficient way to expand the teaching resources of the department for a special topics class. I invite you to review the course website (http://seedandsprout.com/s10_gd492/) for explicit examples of the process.

GAINING FLEXIBILITY THROUGH SPECIAL TOPICS

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Performative Design for Education was a one-time special topics course at NC State University, populated by undergraduate graphic design majors of junior and senior standing. The major goal of the course was to provide a rich research situation to support student engagement with true interaction. "True interaction" in this instance means design that models reader cognition in purposeful ways. This view of interaction says nothing about media – format or medium is too often equated with interaction, when the cognitive experience of the reader should be the real "object" of interest.

Ensuring that students design for interaction is not a straightforward task. Some of the long-standing tenets of design pedagogy tend to hide reading and learning functions behind other kinds of designer intent. The most common form of group critique, for instance, places the designer in front of his or her work, controlling the presentation and making claims about reader interpretation. The absent, abstract reader for the work, therefore, is most often addressed in post facto arguments made during the critique, not in earlier design decisions.

In order to involve students in a program of authentic designing for reader interaction, the course took the instructor's current research as its framework. As a PhD in Design candidate, my work involves design for instructional media in middle school science. In particular, I am interested in how design strategies affect cognitive load and working memory in the comprehension and retention of educational content. I have access to 8th grade science classes at the Centennial Campus Middle School, a Wake County public school on the NC State research campus. The course content for *Performative Design for Education*, therefore, was both the performative framework – a means for addressing interaction through working memory – and the middle school science course of study. These two things came together in actual research, as an applied, not simulated, project in which design students worked to achieve very specific outcomes with real readers.

This could not have been accomplished under a conventional course plan that must cover required curricular content and that prompts students to complete project tasks according to a more general notion of designing. The course was broken down into four phases.

1. A seminar on performative design: Theory must be incorporated into studio courses very carefully. While a lecture-based theory course can cover frameworks as discrete, free-standing topics for discussion, a studio-based course must stay true to making – any theory must be immediately relevant to the task at hand, and explicitly so.

The seminar component of this course was subdivided into 3 subjects: (1) "constitutive metaphor", or how conceptualization of the design task constrains designer performance; (2) "creative memory", or how human working memory architecture is consonant with visual displays; and (3) "cognition to education", or educational practices of connecting cognitive goals to reader performance. Early in this seminar all students read the same material. Later, they read separate but related articles and presented them to their colleagues.

2. Subject area research according to the standard course of study for 8th grade science. Students were divided into small groups to explore the subject matter in question. They studied existing textbooks, sought areas within the course of study with notable visual design affordances, and proposed rich areas for design intervention. They were planning part of a rigorous research project themselves, and following the seminar component they had the knowledge to do so.

3. Individually assigned "tasks" played to known student strengths and served the greater endeavor in myriad ways. One student designed an image-based "mnemonic typeface", meant to increase reader engagement and to be used on all final projects. One student developed a means to map reader interaction through existing textbook pages, to help with analysis. Another student created a multi-page scenario as a teaching test for an 8th grade science student, which served as a dry run of the coming class-wide assignment. These and other tasks served to test the ideas discussed in the seminar. They also put the design students in specialized roles – an authentic form for collaboration at odds with flat everybody-shares-the-mouse group work found in many design courses. The tasks had the additional benefit of acting as a break from the overwhelming "big project."

4. Media-based learning experiences, modeled through multiple-choice and open-ended items as prompts for engagement. Students produced performative media that took the form of small resource booklets, high in text–image integration and schematic structures. But more to the point – and the means through which this course dealt with the interactive reader – design students developed sequences of prompts, as open-book tests, to give purposeful and productive structure to 8th grade engagement with content and media. As such, the design students conceptualized the design task as producing reading and learning experiences, not only physical objects. In each case, the work took the form of interactive print design.

Students in this course, therefore, engaged with graphic design at a metacognitive level. They learned a model (the performative design framework) that addresses designer task conceptualization and its results, they employed the model in a real-world context, and they consciously evaluated it. Students saw a rigorous research project from the inside out. Through the semester's structured process, they produced work with great depth that considered interaction directly, in cognitive terms.

Performative Design for Education could only happen in a program with an at-times open curriculum. Students in the Graphic Design program at NC State University emerge from three semesters of highly structured coursework of studio, typography and imaging courses into three subsequent semesters in which they control the content of their curricular path. Students are able to select design courses based upon their interests and goals. More to the point, it is possible to offer one-time courses that take advantage of temporary opportunities as well as special faculty expertise. There has to be a value system in place that not only requires faculty to make disciplinary contributions aside from teaching (as the tenure system does), but also encourages the fruit of this labor to make its way into the studio.