Message from the Chair

The breadth of HCDE faculty research continues to expand. This year Dr. Cecilia Aragon joined HCDE and Drs. Julie Kientz and Charlotte Lee received NSF Career Awards. We also unveiled a Corporate Affiliates Program to connect with industry partners who are interested in understanding the research of our faculty and students as well as getting in touch with HCDE students early in the year.

This inaugural issue of Explorations describes research agendas of HCDE faculty and students this past year. Professor Cecilia Aragon has been focusing on information visualization and visual analytics for eScience, collaborative creativity and educational games, and usability in daily life. Professor Cindy Atman has been continuing with her research to advance engineering education and engineering design processes. Professor David Farkas has been investigating information design with his projects on designing for selective reading and design patterns for creating consumer information labels. Professor Mark Haselkorn has been examining health care informatics with a goal of improving cognitive processes and workflows of users and raising the productivity and quality of healthcare. Also focusing on health issues, Professor Julie Kientz has been researching how to help parents and healthcare providers detect developmental delays in children, and how to improve sleep behavior and learning.

Focusing on education, Visiting Professor Kerrie Kephart has been investigating engineering students’ development of communication skills and the nature of language use in engineering education. Professor Beth Kolko has been exploring how technologists, social scientists, and scholars collaborate on technology-related development projects. Professor Charlotte Lee has been developing a framework to understand the sociotechnical relationships that comprise cyberinfrastructure, investigating the academic reading that occurs on e-readers, and studying the role of online calendars in helping users maintain relationships. Professor Sarah Pérez-Kriz has been researching science, technology, engineering, and math learning and teaching, so as to promote interdisciplinary communication among nanotechnology graduate students, and investigating the understanding of robots and robotic technologies.

With a focus on user research, Professor Judy Ramey has been investigating the mobile user experience along with refining best practices in usability testing. I have been researching how the design of information affects the user experience with online information, and working with a student team to make WebLabUX (a remote user testing toolkit) into an open source product. Professor Michio Tsutsui has been examining effective feedback and reinforcement of correct usage forms through computer-assisted, language learning materials. Professor Jennifer Turns has been studying the educational significance of asking engineering students to construct portfolios. Professor Mark Zachry has been exploring how people use digital technologies to engage in knowledge work and developing tools to understand these activities and inform the design of new systems. I hope you find this first issue of Explorations as enjoyable as I have.

Happy Reading,

Jan Spyridakis

Professor and Chair
Human Centered Design & Engineering
In this Issue

Scientific Collaboration & Creativity
Cecilia Aragon

Designing Future Engineers
Cynthia Atman

Information Design
David Farkas

Evidence-based Healthcare Informatics
Mark Haselkorn

The Discourse of Inquiry-based Teaching & Learning
Kerrie Kephart

Computing for Healthy Living & Learning
Julie Kientz

Design for Digital Inclusion
Beth Kolko

Computer Supported Collaboration
Charlotte Lee

Learning & Teaching Concepts in Science & Engineering
Sarah Pérez-Kriz

User Experience Research
Judith Ramey

Remotely Assessing the User Experience
Jan Spyridakis

Improving Global Communication through Effective Language Learning
Michio Tsutsui

Are They Prepared? Am I Prepared: Preparedness Portfolios & Portfolio Studios
Jennifer Turns

Communicative Practices in Virtual Workspaces
Mark Zachry

HCDE Academic Programs

About HCDE
Dr. Cecilia R. Aragon, Associate Professor, Department of Human Centered Design & Engineering, directs the Scientific Collaboration & Creativity Lab (SCCL). In this lab, she and her students focus on three primary research areas in the field of Human Computer Interaction (HCI):

- Information visualization and visual analytics for eScience (scientific collaborations, cyberinfrastructure).
- Collaborative creativity in scientific research and educational games.
- Usability in daily life (usability and security via eye tracking, usability for energy saving behavior).

In 2009, Aragon won the Presidential Early Career Award for Scientists and Engineers (PECASE) for her work.

**Information Visualization and Visual Analytics for eScience**

**Sunfall**

Sunfall is a visual analytics software toolset developed for the Nearby Supernova Factory (SNfactory), an international astrophysics experiment. Sunfall combines novel image processing algorithms and machine learning with highly interactive visual interfaces to enable collaborative, user-driven scientific exploration of supernova image and spectral data. Sunfall is the first visual analytics system in production use at a major astrophysics project.

The system resulted in labor savings of nearly 90%. The number of erroneous images was reduced by 70%, and innovative visual interfaces increased human efficiency by a factor of four.

This work was sponsored by the US Department of Energy and the Moore Foundation and was performed in collaboration with astrophysicists at the Nearby Supernova Factory and Lawrence Berkeley National Laboratory.

**Airflow Hazard Visualization**

Many aircraft accidents are caused by encounters with unseen airflow hazards near the ground such as vortices, low level wind shear, or turbulence from surrounding vegetation or structures. Airflow hazards are invisible, and thus the pilot may not be aware of being about to fly into “bad air.”

Aragon and her colleagues developed an airflow hazard visualization system for helicopter pilots. In a flight simulation usability study, the system significantly reduced the simulated crash rate (from 19% to 6.3%) among experienced pilots flying a high fidelity, aerodynamically realistic fixed-base rotorcraft flight simulator into hazardous conditions. This work highlights the importance of understanding principles of human visual perception and cognitive ability and applying this knowledge to the design and implementation of appropriate visualizations in an operationally stressful environment. This work was funded by NASA and was performed in collaboration with researchers at NASA and the US Navy.

**Collaborative Creativity in Scientific Research and Educational Games**

What do astrophysicists operating a large telescope remotely and children building computer games
collaboratively have in common? How do we design interfaces to facilitate creativity in groups? And can games be used to effectively teach students cyberinfrastructure and computing concepts?

Collaborative Creativity
Creativity is arguably humanity’s supreme achievement. Contrary to the popular belief of the “aha” moment of insight, recent work has indicated that creativity is often a series of incremental steps to discovery. As an idea is developed, it is amplified over time in its social context. Aragon and her colleagues are developing and evaluating a dynamical systems theory of collaborative creativity based on distributed affect and interfaces that facilitate socio-emotional communication. This theory is based on studies performed at three field sites comprising astrophysicists, children building computer games online, and engineers at a multinational company.

Collaborative Games for Cyberinfrastructure Education
Aragon and her colleagues and students are developing new technologies to help students learn about bioinformatics and cyberinfrastructure.

This project leverages recent research into the socio-emotional mechanics of online collaboration and multiplayer game development, and the existing social networking structure of BuddyPress, to create a novel educational game that incorporates bioinformatics and cyberinfrastructure (CI) concepts aimed at middle school and early high school students.

By linking collaboration, positive emotions, and social networking to the educational component of the game, students learn that cyber problem solving can be fun and engaging. The goal is to expose more young people to CI concepts and generate more interest in science, technology, engineering, and math (STEM) careers at a critical age where youth are defining their self-identity.

Usability in Daily Life

Usability and Security
Accurate, non-intrusive, and unforgeable identity recognition for desktop and online applications is an area of increasing concern to just about everyone in today’s networked world, with the need for security set against the goals of easy access. It is clear that password verification has major flaws in multiple areas, including usability, accuracy, and security. Aragon and her students are developing an eye-tracking digital signature, a method for biometric identification that combines physiological and behavioral traits and is grounded in a mathematical model of the muscles of the eye globe; they are conducting usability tests of the interface to this biometric technique in common applications. This research is funded by the National Institute of Standards and Technology (NIST).

Thermostat Usability
Residential thermostats control about 10% of national energy use. Programmable thermostats are often assumed to provide energy savings, but Energy Star concluded in 2009 that homes with programmable thermostats were using more energy than homes with manual thermostats.

Aragon and her colleagues performed multiple lab and field studies of thermostats and developed an innovative usability metric for thermostats to facilitate energy saving behavior. This metric is currently being evaluated in Energy Star’s draft specifications for programmable thermostats. This work is funded by the US Department of Energy.

For more information about this research, visit http://faculty.washington.edu/aragon.

Aragon and her colleagues developed an airflow hazard visualization system for helicopter pilots. In a flight simulation usability study, the system significantly reduced the simulated crash rate among experienced pilots flying a rotorcraft flight simulator into hazardous conditions.
Dr. Cynthia J. Atman, Professor, Department of Human Centered Design & Engineering, is the Founding Director of the Center for Engineering Learning & Teaching (CELT), and Director of the Center for the Advancement of Engineering Education (CAEE). Her research focuses on engineering design learning and students as emerging engineering professionals. Through CELT and CAEE, Atman works with colleagues at the University of Washington and across the nation to conduct research that advances engineering education.

**Center Leadership**
The Center for Engineering Learning & Teaching (CELT) focuses on two synergistic activities: research on engineering education and improving engineering teaching through a wide range of instructional development programs. This dual-role structure is based on an awareness that a solid engineering education research base is needed to inform educators about how their students learn, and that this research should drive and support effective teaching. Since 1998, CELT’s model has proven successful in the UW College of Engineering and has had an impact on engineering education at national and international levels.

Established in 2003, the Center for the Advancement of Engineering Education was a multi-institution research center with $12 million in NSF funding. CAEE conducted research on undergraduate learning, faculty teaching, preparing graduate students for teaching, and building capacity in engineering education research. *Enabling Engineering Student Success*, the CAEE final report that was published in 2010, identifies key opportunities for improving how engineering students are currently being prepared for professional practice.

**Research on Engineering Design**
Atman’s research examines how engineering students and practicing professionals solve engineering design problems, as well as the effectiveness of current approaches to engineering design instruction. The broad goal is to more closely align the outcomes of engineering education with the needs of engineering practice. Atman’s research group’s recent contributions include novel methods for representing engineering design processes and detailed analyses of undergraduate engineering students’ design abilities and how they develop during their academic careers.

**Analysis and Representation of Design Processes**
For over a decade, Atman’s research has led empirical studies of engineering students’ and professionals’ approaches to open-ended design problems. Her design process timelines are recognized internationally for their compact but detailed representation of the many different activities involved in the design process. These timelines and the other representations developed by Atman’s group have proven to be valuable tools, both for researching and teaching students about design processes. Current work includes augmenting the visual representations on the cover of the CAEE final report, this word cloud was produced from a set of “local inquiry questions” based on CAEE research and designed to guide local efforts to improve the undergraduate engineering experience.
with multimedia and presenting design processes as 
brief audio clips synchronized with timeline animations.

Consideration of Context During Design
Broad consideration of a design problem’s context is 
an important part of engineering design. For instance, 
successful approaches to the design of a playground 
would include considerations of physical context (e.g., 
attributes of the playground site and surrounding area) and 
social context (e.g., neighborhood demographics). Atman's 
research has examined engineering students' consideration 
of a variety of aspects of problem context. Her more 
recent work examines the extent to which students place 
their design problems in temporal context—i.e., thinking 
across the designed solution's complete life cycle.

Comprehensive consideration of life cycle includes 
everything from the design process to the many steps 
of implementing the solution and beyond, such as maintaining or adapting completed solutions. End-of-
life considerations like disposal or recycling are equally 
important. Such broad consideration of temporal context is critical, given increasing recognition of sustainability 
challenges. Findings from Atman's studies of beginning 
and graduating engineering majors show that current 
engineering education experiences do little to prepare 
students to incorporate consideration of context into 
their design processes. To address this issue, Atman's 
current work includes the development of teaching and assessment methods focusing on this key competency.

For more information about Atman's work, 
please visit the CELT and CAEE websites:

- Center for Engineering Learning & Teaching
  http://depts.washington.edu/celtweb
- Center for the Advancement of Engineering Education
  http://www engr. washington.edu/caee

Comparisons of Student and Expert Designers
Atman’s group has analyzed how novice and expert 
engineers solve open-ended design problems. Both 
solutions and design processes have been compared 
across three groups: beginning undergraduate engineering 
majors, graduating majors, and practicing professional 
engineers. Methods including the timeline analyses 
have led to a detailed understanding of the development 
of design ability, including the following findings:

- Engineering experts 
distinguish themselves 
  from undergraduates in the 
effectiveness of their problem 
scoping, how much problem-
relevant information they 
gather, and time spent on a 
wide range of design activities 
(e.g., generating and evaluating 
solution ideas).
- Graduating engineering majors 
  are, as expected, more similar 
to experts than beginning 
majors are, with respect to 
design process and solution 
quality.
Designing for Selective Reading

Working with several groups of students, Dr. David Farkas, Professor, Department of Human Centered Design & Engineering, has investigated the broad design concepts that underlie all forms of Designing for Selective Reading (DSR). In the present era, knowledge workers struggle with information overload while other readers, especially digital natives, often resist reading longer documents. Yet longer documents are necessary in order to communicate thoroughly and meaningfully about complex topics. One way to support knowledge work and encourage the wide dissemination and use of longer documents is to improve how we design for selective reading—hence the DSR Project. Ideally, the DSR Project can provide a near-seamless experience when readers choose what topics within a document they wish to read and the desired level of detail.

One of Farkas’ students, Quan Zhou (PhD 2008), designed and empirically validated QuikScan, an innovative document format that provides pinpoint navigation from multiple within-document summaries to the full text and improves comprehension by 41%. SwitchBack is a working prototype that addresses the problem of lost context—the information deficits that arise when you switch from brief to detailed reading within a document. The newest design, TripleSwitch, has sparked a commercial venture.

Managing risk with market-based financial instruments

15-1 Developing countries had been encouraged to manage price risk with market-based financial instruments. These are: (A) basic forwards, (B) futures and options contracts, and (C) commodity-backed derivatives.
15-2 Forward contracts provide some (usually short-term) hedge against price risk but are not ideal hedging instruments.
15-3 Futures and options contracts are better hedging instruments because they are traded on organized international commodity exchanges.

The Battle of Hampton Roads

The Battle of Hampton Roads was the battle between the Union and Confederate Navy, and it is considered one of the most significant naval battles of the Civil War. The battle took place on March 9, 1862, and it marked the first major naval battle of the Civil War.

Risk factors and mortality in patients with Staphylococcus aureus bacteremia

Fu-Der Wang MD, Yin-Yin Chen RN, Te-Li Chen MD, and Cheng-Yi Liu MD.

- **Background:** Infections due to methicillin-resistant Staphylococcus aureus have become increasingly common in hospitals worldwide.
- **Methods:** We analyzed the clinical significance (mortality) of MRSA and methicillin-susceptible S aureus bacteremia in a retrospective cohort study in a 2900-bed tertiary referral medical center. Survival and logistic regression analyses were used to determine the risk factors and prognostic factors of mortality.

1. A retrospective cohort study was performed to determine and compare mortality of Nosocomial MRSA and MSSA bacteremia. The study took place in a 2900-bed tertiary referral medical center.
2. Each episode of Nosocomial infection was defined according to standard definitions proposed by the Centers for Disease Control and Prevention and verified by an infectious disease specialist.
Information Design

A Pattern Library for Consumer-Information Graphics

Consumers are empowered by clear and informative point-of-purchase consumer-information graphics ("labels"). Jerrod Larson (PhD 2010), another student who worked with Farkas, designed and empirically validated an environmental impact labeling system with significant advantages over existing designs. Drawing on Larson's work, students in Farkas' Information Design course (HCDE 510) explored the design requirements for consumer-information labels encompassing health and safety, product quality, and other domains. Then they created 150 design patterns (enhanced guidelines) for creating these labels. Undergraduate students, with key contributions by Steve Naranjo, created a website (http://labelpatterns.org, now a working beta version) to host these patterns and make them available to the environmental policy and graphic design communities.

For more information about this research, visit http://faculty.washington.edu/farkas.

Students in Farkas' Information Design course (HCDE 510) explored the design requirements for consumer-information labels encompassing health and safety, product quality, and other domains. Undergraduate students, with key contributions by Steve Naranjo, created a website, http://labelpatterns.org, to host these patterns and make them available to the environmental policy and graphic design communities.
Dr. Mark Haselkorn, Professor, Department of Human Centered Design & Engineering, is leading a University of Washington team as part of the National Center for Cognitive Informatics & Decision Making (NCCD), funded by the Office of the National Coordinator for Health Information Technology (ONC) in the US Department of Health and Human Services (HHS) under the Strategic Health IT Advanced Research Program (SHARP). Their charter is research on health care informatics that will improve the cognitive processes and workflows of its users, and measurably raise the productivity and quality of clinical care.

**Need**
There is critical, nation-wide need to improve health care while reducing its cost and improving access. Health information technology (HIT) has great promise, but the adoption rate of electronic medical records (EMR) is less than 15% by private providers. Health care leaders have serious concerns about disrupting the workflow of clinical care, increasing treatment errors, excessive training and tech support, and steep start-up costs.

Modern health care must be coordinated over time and across specialty organizations that provide for many patients. Medicine is information-intensive work that spans the tasks of individuals, small teams, and different organizational processes. Even patients, themselves, are increasingly important participants in health care. One of the fundamental ways that HIT must serve to improve health care is by enabling workflows across boundaries that are far more coherent and understandable, which are keys to safety, efficiency, timeliness, and equity.

**Situation**
Conventional HIT development is feature-based and treats workflows as responses to the HIT that will eventually emerge after deployment, be recognized, and can possibly be revised if their efficiency or quality are bad enough. Given their large start-up cost and unpredictable impact, the decision to invest in HIT is often seen as too risky.

**Target**
Their vision is to make HIT serve as a reliable means to implement the policies of health care leaders and private clinics, such as increasing the productivity and quality of the care they provide, or reducing administration costs.

**Proposal**
Like many artifacts of clinical care, workflows can be designed and validated with objective evidence. Recent scientific research has clarified the principles for the way information drives the decision-making and workflows of clinical care [1–4]. The principles can be exploited to make improved workflow a planned part of HIT development. Information flow and workflow can be developed as a pair of matched designs. When the workflow is measurably more efficient and/or of better quality, HIT development can become evidence-based instead of feature-based.

**Measures, Models, and Translation**
MATH is a software tool suite for “building-in” measurably superior care workflows to the development of HIT systems. MATH Flow extends the Object Management Group’s standard for business process modeling (BPMN).
with editors and dictionaries for information modeling. They capture the flow of information needed to support improved workflow. MATH View imports the dictionary and translates information flow into key software artifacts, such as an information architecture, which can be imported to the Unified Modeling Language for technical analysis and design of the software.

Benefits
This situation creates pent-up demand and tremendous opportunity for evidence-based HIT systems. HIT adoption rates will increase as health care leaders can participate in concept design, understand what they are paying for, and have the visibility of progress they need to direct investment.

For more information about this research, visit http://faculty.washington.edu/markh.


Kerrie Kephart
Visiting Assistant Professor
PhD, University of Wisconsin, Madison

Newly arrived from the University of Texas, El Paso (UTEP), Dr. Kerrie Kephart, Visiting Assistant Professor, Department of Human Centered Design & Engineering, is an applied linguist who uses discourse analysis and ethnographic observation to investigate language use and learning in engineering education. Her methods involve audio- and video-recording of students and faculty engaged in natural interaction in classrooms, labs, and research group meetings, and subsequently analyzing transcripts of these interactions. Her work aims to:

- Describe effective teaching, learning, and group management practices.
- Analyze their effects on students’ learning and development.
- Distill them as generalized stances, approaches, and techniques that can be broadly adopted.

Kephart’s work with colleagues and students in engineering and education at UTEP was supported by the National Science Foundation Course Curriculum and Laboratory Improvement Program (CCLI) and focused mainly on two approaches to teaching and learning: inquiry-based methods in engineering classrooms, and cooperative learning for managing and developing inclusive research groups.

The Discourse of Inquiry-based Teaching and Learning

Although most engineering students develop factual and procedural knowledge through their course work, they may graduate and still lack deep, conceptual understanding and ability to apply their knowledge. Inquiry-based teaching has been shown to be more effective at fostering deeper conceptual understanding than traditional teaching methods, but it is challenging for many faculty to adopt because it requires “unlearning” old habits. Inquiry methods involve designing hands-on, learner-driven educational experiences that enable students to discover meanings and make connections to practical applications, and that lead to enduring conceptual understanding. Kephart’s research aims to demystify the structures and processes of inquiry-based methods for instructors and people who train them.

Kephart’s analyses describe how inquiry-oriented instructors manage to:

- Guide students’ discovery by posing—or encouraging students to pose—intriguing problems (simple or complex) and inviting students to engage in theory-building.
- Affirm students’ intelligence, trusting that they will come to deep, accurate, and enduring understandings through interaction and exploration, rather than from being fed the “right” answers.
- Provide strategic feedback, listening carefully to what students say and watching what they are able to do in order to provide responses that enable them to take the next step toward discovery.

The Recursive Cycle of Inquiry

With a broader context:
- Sociohistorical — beliefs & values of participants; the era or “moment in time”
- Disciplinary — state of knowledge; problems to be solved
- Institutional — constraints and affordances of the immediate physical and political environment

The Recursive Cycle of Inquiry

INQUIRY

fosters

ENGAGEMENT

which leads to

UNDERSTANDING

which supports

APPLICATION

The Recursive Cycle of Inquiry.
The Discourse of Inquiry-based Teaching & Learning

Discourse Analytic Framework

Situated Learning, Cooperative Learning, and Affinity Research Groups
The Affinity Research Group (ARG) model is a set of practices built on a cooperative team framework to support the creation and maintenance of inclusive research groups in which students learn and apply the knowledge and skills required for research, team work, and effective communication. The ARG model is being adopted at colleges and universities throughout the US because it has proven to be highly effective at engaging students from historically underrepresented groups in undergraduate research and retaining them in engineering and science majors. Kephart’s research with the ARG model has described student and alumni experiences with ARGs and provided detailed explanations of the principles and methods of the model toward easing its dissemination and adoption.

For more information about this research, contact Kerrie Kephart at kkephart@uw.edu.
Dr. Julie A. Kientz, Assistant Professor, Department of Human Centered Design & Engineering, directs the Computing for Healthy Living & Learning (CHiLL) Lab. In this lab, she and her students design, develop, and evaluate applications to support individuals and families in pursuing their health and education goals. They explore how novel technologies, such as ubiquitous and collaborative computing, can help with record-keeping, data review, and behavior change. The main research focuses on healthy living, healthy learning, and new approaches to doing research in this space.

**Healthy Living**

In this space, Kientz and her students focus on designing technologies to support preventive healthcare, as well as help individuals try to meet their goals for health on their own and in collaboration with their doctor. The two main projects in this space consist of Baby Steps and supporting healthy sleep behaviors.

**Baby Steps**

In this project, Kientz and her team are designing technology to help detect, record, and track developmental progress in children during their first five years. They aim to help parents and healthcare providers detect developmental delays such as autism or emotional disorders earlier, which can improve the effectiveness of interventions. This work is sponsored by the National Science Foundation on a Faculty Early Career Development (CAREER) grant and is in collaboration with Seattle Children’s Hospital.

**Healthy Sleep Behaviors**

Sleep is a key aspect of health, yet relatively underemphasized compared to diet and exercise. Kientz is exploring how ubiquitous computing can help play a role in influencing sleep behaviors, aiding in the diagnosis of sleep disorders, and promoting good sleep hygiene. This work is funded by Intel Labs, and is done in collaboration with researchers at Intel and the University of Washington Sleep Institute.

*Baby Steps technology is being developed to help detect, record, and track developmental progress in children during their first five years.*

Kientz is exploring how ubiquitous computing can help play a role in influencing sleep behaviors, aiding in the diagnosis of sleep disorders, and promoting good sleep hygiene.
Healthy Learning
Education is another major component of healthy living. In this research space, Kientz and her colleagues have aimed to develop new technologies for helping individuals learn better and improve the delivery of education to students. The primary projects in this space are in education for children with autism and designing computing interfaces that make people think.

Autism Education
Kientz has developed a software tool, Abaris, which supports therapists and teachers who perform Discrete Trial Training therapy, a current best practice intervention for children with autism. The system uses pen, speech, and video indexing to help improve access to data and aspects of decision-making. This project is in collaboration with individuals at UW’s Experimental Education Unit.

Interfaces that Make us Think
Technology has made many aspects of our lives easier, but it has also reduced the need to exercise certain parts of our brains. Kientz and her directed research group students are investigating how technology can be designed to make us think in new and different ways to prevent cognitive decline. They are integrating mental fitness exercises into everyday activities, such as email, web browsing, mobile phone calls, and navigation systems.

New Approaches
Kientz and her students are also working toward researching and developing new approaches to applications for health and education that have more general applicability. These research projects include designing empathic interfaces and adaptable persuasive technologies.

Empathic Interfaces
The CHiLL lab is working to understand and define ways that technology can be designed to be more empathic and sensitive in the delivery of health care information, and especially concerning health news such as a diagnosis or disorder. They believe this can reduce anxiety and concern over health outcomes.

Adaptable Persuasive Technology
Many times, persuasive technologies are designed to be one-size-fits-all. Kientz and her students are looking at ways that technologies can be adapted based on a person’s individual characteristics, such as personality or lifestyle. They believe this will help them to be the most effective at persuading users to live healthier lives over the long term.

For more information about this research, visit http://faculty.washington.edu/jkientz.
Dr. Beth E. Kolko, Professor, Department of Human Centered Design & Engineering, directs the Design for Digital Inclusion Lab (DDI). DDI researchers think about the other five billion potential users of the Internet and emerging technologies. They think about computing beyond the workplace or the desktop, and they think broadly about technologies that can help address the challenges of everyday life. Central to the lab’s work is to demonstrate how technologists, social scientists, and humanities scholars can collaborate on technology-related development and implementation projects.

DDI’s projects range from designing and developing a portable ultrasound machine for midwives in Uganda and investigating gaming patterns of youth in Brazil to researching the needs of homeless and other transit-dependent communities in the United States.

The DDI group focuses on innovative approaches to technology design throughout a product lifecycle from ideation to use—with the goal of emphasizing diversity of users and usage contexts. The group’s most current work focuses on technology development for resource constrained environments in order to counteract what could be called a failure of imagination in terms of how devices, software, and services are designed. With the advent of newer, smaller, and cheaper technologies, the user base and use scenarios for information and communication-centric technologies has expanded to include a broader base of the global population.

Kolko and her students are also doing groundbreaking work on research methods, helping individuals and organizations adopt user-centered design methodologies so they produce reliable results when deployed in different and challenging research contexts.

Global Health As a People Problem As Well As a Technology Problem: Portable Midwives’ Ultrasound

Ultrasound imaging is an effective tool for identifying maternal mortality risk factors, but it’s also a complex and expensive technology that requires extensive training. As a result, ultrasound is nearly absent in many rural healthcare facilities in developing regions. To meet the challenge of how to effectively incorporate ultrasound technology into existing healthcare systems, Kolko’s lab has partnered with colleagues in the Departments of Radiology and Computer Science and tackled the central issue of the ultrasound user interface. They have taken off-the-shelf components—including a USB ultrasound probe and a touchscreen netbook—with a total cost of around $3500, and created a functional ultrasound device that reframes the challenge of ultrasound use in terms of people rather than technology. Compared to currently available ultrasound devices that cost around $40,000, their device simplifies the user interface while maintaining functionality to allow midwives to detect three common obstetrical conditions: placenta previa, multiple gestations, and breech presentation. They have tested the accuracy of ultrasound measurements, image quality, and compared the diagnostic capabilities of the device to commercial machines. Later this
Design for Digital Inclusion

spring, they will travel to Uganda to deploy the device in the field with midwives. Current funding from a Bill and Melinda Gates Foundation Grand Challenges Exploration Award is enabling undergraduate and graduate student involvement with research and fieldwork.

Understanding Technology Use in a Global Context

Nine years of research in the Central Asian countries of Kazakhstan, Kyrgyzstan, Tajikistan, and Uzbekistan allowed DDI to present some of the earliest work on the importance of information and communication technologies in developing regions. What began as a project to track the impact of the Internet in a region experiencing early adoption became a longitudinal exploration of how multiple technologies can meet international development challenges. In addition to producing the only extensive social science data on technology use in Central Asia, DDI members worked on several technology interventions specifically designed for low resource regions. They piloted an SMS-based social rating system that allowed users to create user groups and share ratings with friends and family; they collaborated with colleagues in computer science to create an SMS-GPS transportation information system to allow buses and riders to create a grassroots schedule alert system, and they refined both usability and design ethnography methods for use in low resource environments.

They have also looked at the impact of computer games in developing regions, both in Central Asia and Brazil. While kids in these places may not be using Xbox Kinects, they are still exploring technology through play, and DDI’s current project on social networking and gaming in Brazil is helping them discover what kinds of productive learning about technology people gain when they mess around on computers for fun.

Creative Approaches to STEM Education

DDI research over the years has highlighted some unexpected aspects of innovation, including what can be done with few resources and little official expertise. In that spirit, DDI has launched its own innovation lab under the guide of the “Makerbot Project.” First drawing in students to build three-dimensional printers from kits, this project engages undergraduate and graduate students in hands-on learning that encourages them to explore technical realms outside the core of their coursework. Students have learned three-dimensional modeling and printed objects, they’ve dived into arduino programming, played with with Bluetooth, Radio Frequency Identification (RFID), and infrared sensors, and they are currently working on creating wearable technology that tracks face-to-face interactions with their social network.

These are just some of the recent projects in DDI. DDI researchers also helped a local NGO create usability testing protocols (for their testing in Ghana) for an information-delivery device called the Talking Book that would actually produce actionable data; DDI has conducted design ethnography with Seattle-based homeless and other marginalized populations to better understand how public transit can meet their needs; and DDI has worked on creating games that help spread the messages of international development projects. DDI works with students from a variety of disciplines; DDI publishes, presents, and engages the community, and hopes their work can lead to design principles and designed products that reach diverse users and make a meaningful difference in their lives.

For more information about this research, visit http://depts.washington.edu/ddi.
Dr. Charlotte P. Lee, Assistant Professor, Department of Human Centered Design & Engineering, directs the Computer Supported Collaboration (CSC) Laboratory. In this lab, she conducts research to inform the design of information systems for collaboration. She investigates the development and uses of information infrastructures in science and engineering, computer supported cooperative work (CSCW), and computer supported cooperative leisure. Recent projects have explored these themes in domains like genomics, ecology, functional brain imaging, and museum exhibit design. The lab primarily uses qualitative social science research methods, often conducting interviews or observational fieldwork in places of work and leisure to holistically investigate information systems as evolving social and technical entities.

Cyberinfrastructure and eScience: Collaborative Development

Interacting with Cyberinfrastructure in the Face of Changing Science

This research will develop a framework to understand the set of sociotechnical relationships that comprise cyberinfrastructure (CI). Projects are often unable to reflect on how CIs are used and created in the current state of rapid scientific change where multidisciplinary approaches are putting pressure on disciplinary boundaries. This project will investigate the following questions. How do scientists and engineers decide which CI resources (e.g., databases and tools) to use and under what circumstances? Under what circumstances do scientists and engineers decide to create their own resources? How do scientists and engineers mix disciplinary practices within their own laboratories? When do scientists and engineers adopt hybrid identities (e.g., computational biologists and bioinformaticists)?

Leveraging Development Expertise Across Cyberinfrastructures

This ongoing project is undertaking an unprecedented comparative ethnographic study of two large cyberinfrastructure (CI) building and research organizations: the National Center for Supercomputing Applications and the San Diego Supercomputer Center. Each of these organizations participates in multiple CI projects of varying size and complexity. Qualitative research methods will be used to understand how work practices change and develop over time. This project is funded by NSF Award OCI-083860.

Collaboration in the Development of Cyberinfrastructure

Cyberinfrastructures are large-scale distributed scientific enterprises supported primarily through advanced technological infrastructures such as supercomputers and high speed networks. This ongoing project is systematically studying the actual practices of cyberinfrastructure development and use and is also examining the transformations that it is created to engender. Ethnographic methods are being used, including participant-observation and semi-structured interviews. A nascent metagenomic cyberinfrastructure project, Community Cyberinfrastructure for Advanced Microbial Ecology Research Analysis (CAMERA), is serving as the field site. This project will continue into 2011 and examine the effects of an altered human infrastructure on the operation of a cyberinfrastructure project. This project is funded by NSF Award IIS-0712994.
e-Readers and Academic Reading: Supporting Sophisticated Reading Practices

The Academic Potential of E-readers

This project investigated the sophisticated academic reading practices of college students, and how the introduction of an e-reader helps and hinders these practices with research study spanning several months. This project investigated how graduate students accomplish their academic reading and integrate an e-reader, the Amazon Kindle DX, into their academic reading practices. By building on literature describing how students read and taking a more holistic view of reading practices and how they play out with, through, and around an e-reader, the research team uncovered an array of sophisticated and idiosyncratic ways of reading that are essential for adequately supporting academic reading practices. By understanding not only reading tasks, but also reading goals and techniques, as well as how students switch between these, the team rethought approaches to e-reader design.

Online Calendars as Social Media: Calendaring as Relationship Work

Investigating the Role of Online Calendar Use in the Cultivation and Maintenance of Relationships

Relationship work and negotiations of the most personal kind play out in calendaring practices and in discussions around calendar usage. Sharing an online calendar requires a time commitment and often causes others to adjust their behavior based on what, when, and how information is shared. This project is studying how relationships play out through online calendars, and how people use their calendars to manage their relationships. This project is funded by a Google Research Award.

For more information about this research, visit http://depts.washington.edu/csclab.
Dr. Sarah Pérez-Kriz, Assistant Professor, Department of Human Centered Design & Engineering, conducts research focusing on science, technology, engineering, and math (STEM) learning and teaching in both formal and informal environments. Currently, she is conducting research on two distinct areas of STEM learning: (1) promoting interdisciplinary communication among nanotechnology graduate students, and (2) investigating people’s understanding of robots and robotic technologies. She is the director of the Human-Robot Communication Laboratory (HRCL), home to Bucky, a PeopleBot robot.

**Promoting Interdisciplinary Collaboration in Nanotechnology**

This NSF-funded project is a collaboration between Pérez-Kriz and University of Washington professors in the Department of Materials Science (Marco Rolandi) and the Division of Design, School of Art (Karen Cheng). Along with a postdoctoral researcher and two research assistants, the team is exploring how to improve interdisciplinary communication and collaboration among nanotechnology students. The project tests the hypothesis that students who receive training in visual communication (i.e., thinking about the intended audience of a graphic and disciplinary goals of the creator) can be better interdisciplinary communicators. In the service of testing this hypothesis, the team has designed a series of experiments that evaluate whether explicitly thinking about the intended audience and creator’s disciplinary goals aids...
in creating and comprehending nanotechnology graphics. Data from these experiments will allow assessment of whether training in visual communication is a viable pedagogical tool for encouraging interdisciplinary thinking.

Robots, Science Fiction, and the Future

Pérez-Kriz has been working closely with several HCDE students to evaluate how people learn about technologies that are not commonly available to the general public, like robots. Recent studies on human-robot communication conducted in the HRCL have shown that people have a lot of faith in a robot’s intelligence and cognitive capabilities, but are much less confident about a robot’s linguistic and social capabilities. Furthermore, the lab has shown that the gender of a robot’s voice biases people to make stereotypical assumptions about the robot’s knowledge and reactions. Lab members have been working on exploring how these results correlate with how robots are typically portrayed in American science fiction films. Not surprisingly, science fiction seems to be a big contributor to people’s understanding of robots. An analysis of several popular science fiction films revealed that fictional robots often show high levels of intelligence, but a lot of variability in how well they handle social tasks.

The results of the human-robot interaction studies conducted in the HRCL have been used to create outreach materials to illustrate some of the differences between fictional and real robots. Last spring, under Pérez-Kriz’s supervision, 20 University of Washington students from across the Seattle campus worked together to put on several outreach events to the local community. During these events, students used posters, short films, and commercially available robots to teach people about the differences between real and fictional robots.

Currently, Professor Pérez-Kriz is working with a group of students on how to train professionals to engage in a new human centered design methodology called science fiction prototyping. Science fiction prototyping is a collaborative tool that allows researchers to think about the future by writing realistic science fiction stories. Through a partnership with Intel Corporation, Pérez-Kriz and her students are currently working on publishing a volume of science fiction prototypes, creating training materials for professionals, and writing several academic articles about science fiction prototyping.

Pérez-Kriz has also given presentations about science fiction and robotics to local organizations such as the Seattle Robotics Society and Dorkbot Seattle.

For more information about this research, visit http://faculty.washington.edu/kriz.
Dr. Judith Ramey, Professor, Department of Human Centered Design & Engineering, has research interests in the broad area of user experience and the related area of usability research. Most recently, she has directed research groups on the mobile user experience and on best practices in usability testing.

Mobile User Experience
Ramey’s research group on the mobile user experience has explored a wide range of questions.

First, Ramey’s research group focused on the ways that people access the Web on their personal mobile phones: What do they do? Why do they do it? Where do they do it? The first part of this research took place in 2006–2007; participants in the study reported in via an online message system each time they used their phones to access the web. After a period of reporting their live use, they came in to the Laboratory for Usability Testing and Evaluation (LUTE) for an interview about their activities. Using content analysis of the messages and interviews, the group constructed a taxonomy of behaviors, motivations, and contexts of use for mobile Web access. They found that people used their phones for monitoring information and status checking, in-the-moment and longer-term planning, and diversion. Interestingly, mobile phone usage was not always mobile; people chose to use their phones at home, even when only steps from their laptops. On the other hand, they chose not to do complex transactions on their phones, instead reserving those activities for their laptops or home computers.

The results of this study, however, were called into question after the introduction of the iPhone, so a second study was conducted with two goals: to see if new data from a more recent period of usage would validate the findings from the first study, and to compare iPhone usage to non-iPhone usage. The second study confirmed that 95% or more of reported Web access by phone by participants was covered by the taxonomy of behaviors, motivations, and contexts of use that was originally found. There was also no significant difference in patterns of use between iPhone and non-iPhone users.

Second, a different group of students in Ramey’s research group did an extensive literature review to look at the use of mobile phones in an educational setting (m-learning), focusing on: (1) theoretically motivated use rather than...
simple utilitarian use (online consultation of assignment schedules, etc.), and (2) use integrated into the framework of the formal classroom. Using the constructivist “How People Learn” framework as the theoretical lens, this project identified ways that m-learning blended informal and formal learning, supported learning as an act of self-service, and facilitated community and teamwork. Other students have studied the use of Quick Response (QR) codes and games and augmented reality to enhance mobile learning. Finally, a student in this area conducted a systematic literature review to determine the state of research into the design of mobile user interfaces for non- and semi-literate people in the developing world.

Best Practices—Usability Testing

Eye tracking has enjoyed something of a resurgence as a usability tool because of recent advances in eye-tracking systems design. After extensively exploring the literature of eye-tracking and analyzing the kinds of usability questions that eye-tracking can help us answer, Ramey’s eye-tracking research group decided to use eye-tracking to explore a more fundamental user-research question: In a usability test, when users review what they did and are asked to state what they were thinking as they worked, are they able to provide an accurate account? That is, does the so-called “stimulated retrospective thinking-aloud protocol” yield accurate data? The group did a formal experiment, using eye-tracking to gather data, which confirmed that, after doing a set of tasks, participants did in fact talk about the things they were looking at, in the order in which they looked at them. These findings support the validity and usefulness of the retrospective think-aloud as a user-research tool.

A different group of students focused on documenting best practices in usability testing, starting with techniques for prompting during a usability test. After doing an extensive literature search, they planned and created a set of videos to illustrate constructive prompting strategies: use of open-ended questions, ways to manage task timing and flow, etc. These videos are the beginning components of a library of useful information for user researchers to be added to the LUTE website.

Future Work

Ramey plans to continue her work in these areas, with a focus on public health education for underserved populations, nationally and internationally. The technology with the widest reach both demographically across all socio-economic groups as well as internationally across both the developed and developing world is the mobile phone. It has enormous potential as a means of providing broad access to public health information and education. Ramey is pursuing a number of collaborations focused on investigating these issues.

For more information about this research, visit http://www.hcde.washington.edu/ramey.
Understanding the experience of users who are browsing information on the web is a complex undertaking. This issue is of concern to students working with Dr. Jan Spyridakis, Professor and Chair, Department of Human Centered Design & Engineering, in her Internet-Based User Experience Lab (IBUXL). Researchers in this lab have been investigating how different web design features affect users’ comprehension, perceptions, and behavior. Given that the nature of web browsing is affected by the user’s natural environment, researchers in IBUXL use tools that instrument websites for multivariate studies so they can remotely assess readers in their own web browsing environments. Understanding the outcomes of the naturally occurring user experience has high ecological validity and great generalizability for the creation of design guidelines.

**WebLabUX**

The research studies undertaken by researchers in Spyridakis’ Internet-Based User Experience Lab (IBUXL) have been enabled by WebLabUX—a tool being developed and refined in IBUXL for running automated, online multivariate studies to assess user behavior and performance in online spaces.

WebLabUX facilitates researchers in constructing A/B or multivariate testing of web design, delivering unmoderated experimental conditions, administering surveys and instructions, recording navigational behavior (including types of links clicked) and survey responses, and identifying disingenuous user behavior. During 2010–2011, the IBUXL team has re-engineered their original PHP-based WebLabUX toolkit to create a new open source, user-friendly WebLabUX. Driven by user-centered principles, this new design features a study manager that allows research teams to collaboratively design and run multivariate studies.

**Structural Cues and Online Spaces**

Many previous studies conducted by researchers in IBUXL have focused on understanding the effect of different structural cues on user comprehension, perceptions, and behaviors. Structural cues reveal content relationships and help website readers form mental macrostructures of the information. In online spaces, these cues consist of hyperlinks, navigations menus, graphical overviews, site maps, preview paragraphs, and so on.

**Sample Studies**

Some of IBUXL’s most recent works has focused on:

- Textual previews and navigation menus
- Hyperlink phrasing
- Intra-article navigation

In a typical study, users enter an experimental website remotely from wherever they like using any platform.

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*Tentative Study Flow*

1. **User sees consent form, pre-surveys & study instructions**
2. **User browses one condition of the study website**
3. **User completes perceptions & comprehension surveys**
Assessing the User Experience

Hierarchical Tab Menu Absent

Hierarchical Tab Menu Present

Study of effect of text previews and navigation menus on user behavior.

Their experience resembles what is shown in the diagram above. Users first encounter a study consent form, study instructions, and usually pre-surveys that ask about demographics. Next, they browse a website that displays one of the many website conditions defined by the researcher. After the users have sufficiently browsed the study website, they move on to perception and comprehension surveys. In the background, WebLabUX remotely administers the study: it assigns website users a study ID and one of the website design conditions. It moderates the study protocol by showing consent forms, instructions, and surveys in the correct sequence during the study; and it collects and stores survey responses and browsing behavior from each participant in the study.

The study shown above provides a typical example of what WebLabUX can administer. This study examined the effect of text previews (subordinate links in a list with no preview, links embedded in a preview, links listed below a preview) and navigation tab menus (absent, present) on user comprehension, perceptions, and navigation behaviors within an information-dense website.

Outcomes

IBUXL’s series of studies of the effect of structural cues on the user experience in online spaces have revealed that web designers should understand the need for explicit cueing of structure as it can improve comprehension while also providing elements that users prefer. More specifically:

- Web users like what is familiar (e.g., navigation menus) but perform better with multiple types of signals (e.g., links embedded in a preview).
- People do not always like what is good for them (e.g., in the study cited here, users’ ability to make inferences across text in a complex website was positively influenced by previews with the embedded links, but the users did not like them).
- Users may perform differently from what they report in perception survey.

The results of IBUXL’s multiple studies must always be put into context as all design decisions must be made in context. If forced to choose, site designers may have to decide whether they want a loyal customer with positive perceptions or an educated customer with good comprehension.

Next Steps

IBUXL is in the final stages of preparing Open WebLabUX for release in 2011. Lab members are interested in studying how the WebLabUX approach affects web designers’ design behaviors since it gives designers the ability to become experimental researchers and incorporate a hypothesis-driven quantitative approach for validating individual design decisions into a larger scope of design activities. Finally IBUXL researchers are looking forward to two upcoming studies. One will focus on assessing which layout in a set of page layouts enables a software developer to learn a new software technology most quickly to the point where the developer can use it successfully in a new program. The other will focus on testing the experience of users researching retail purchases online using mobile phones while shopping in brick and mortar retail spaces, and incorporating mobile testing tools into Open WebLabUX.

For more information about this research, visit http://depts.washington.edu/ibuxl.
Although English is the common language of the global marketplace, it is not used universally. In addition, while technologies for inter-language communication (e.g., machine translation) are advancing, they are still not sufficient. Thus, effective foreign language learning remains a central issue for professionals worldwide. Dr. Michio Tsutsui, Professor, Department of Human Centered Design & Engineering, and Director, Technical Japanese Program, is conducting research that addresses this issue; specifically, his research focuses on effective feedback and on the reinforcement of correct usage forms.

Computer-Assisted Learning for the Reinforcement of Correct Forms

To be able to generate grammatically correct sentences, learners must first have accurate knowledge of each grammar item and, second, must internalize that knowledge through oral production and other types of practice. Tsutsui’s ongoing Japanese linguistics research to reveal the usage rules of individual grammar items is geared in part to help learners achieve the first step (i.e., accurate grammar knowledge). His publications in this area include a three-volume grammar series published by The Japan Times, which covers basic through advanced grammar items.

To help learners achieve the second step (i.e., internalization of what they have learned), Tsutsui is currently developing computer-assisted learning materials for the reinforcement of correct usage forms. For example, the materials under development enable learners to: (1) practice target grammar forms orally with the aid of sounds, text, and graphics; (2) practice them orally in context in an interactive fashion; and (3) listen to dialogues or passages that contain target forms and determine the appropriate meaning when forms have multiple meanings.

The materials are in a modular form according to grammar item so that learners can practice by focusing only on items they need to work on.

The above research is a collaborative project with faculty from the University of Michigan.
Global Communication through Effective Language Learning

Delayed Feedback
Feedback is an essential part of second language learning. Copious amounts of research have been done on feedback in language learning, but most of that research has been on feedback given interactively. Interactive feedback, however, cannot be used for presentations and speeches where learners do not interact with their instructor during their performance. Tsutsui’s research focuses on what is called delayed feedback, that is, feedback given to the learner in written or oral form after a performance. Although this method is widely used, classroom experience suggests that it is often not effective. Prior to Tsutsui’s research, however, very little research had been conducted to find more productive methods for delayed feedback.

Tsutsui’s preliminary research suggests that: (1) errors can be categorized into several types according to the level of the learner’s linguistic and socio/cultural knowledge and the level of internalization of that knowledge; and (2) the way of giving feedback should be different depending on the type of error. Language Evaluator is a delayed feedback tool developed by the Technical Japanese Program under his leadership. This application demonstrates that technology can provide different kinds of feedback according to the type of error.

Language Evaluator (LE) — Overview

Language Evaluator Overview.

Significantly, Language Evaluator’s application areas are not limited to foreign language education; this tool can be used for any performance training, including speeches and presentations, acting, and music.

For more information about this research, visit http://tjp.washington.edu/main/le.
As educators and educational researchers, it is not uncommon to ask students if they are prepared (e.g., in graduation surveys). However, what would happen if students were asked to explain or even justify their judgments (i.e., address the question, in what ways are you prepared)? Further, what do students actually know about their own preparedness? Dr. Jennifer Turns, Associate Professor, Department of Human Centered Design & Engineering, explores the educational significance of asking students to do just this. In particular, she examines what happens when students are asked to construct portfolios in which they make arguments about their own preparedness for future activity? Her research suggests that this activity helps them engage in profoundly important questions: How do my experiences (represented by the left side of the figure below) provide evidence of what I am prepared to do (represented by the right side of the figure)? Which experiences count as evidence of my preparation? To what extent am I prepared? What else do I need to do in order to strengthen my preparation?

Turns’ research suggests that constructing portfolios helps students engage in questions like: “How do my experiences [represented by the left side of the figure above] provide evidence of what I am prepared to do [represented by the right side of the figure]?”

Prepared Portfolios and the Portfolio Studio
A portfolio is a collection of work with a purpose. A preparedness portfolio is a collection of work that makes an argument about one’s preparedness for a future activity. When this term preparedness portfolio is unconstrained, Turns uses it to refer to portfolios that can draw upon any competency associated with engineering and any experience from one’s life (life-wide). Given this starting point, variations in the portfolio activity can come from constraining the portfolio in terms of experiences and/or in terms of competencies. For example, a student can be asked to generate a portfolio about a specific competency (e.g., an argument about one’s preparedness for communication in engineering, for leadership in engineering, or for ethical behavior in engineering) or a portfolio that is specific to an experience (e.g., an argument about how a co-op experience prepared one for engineering, or how a research experience or course prepared one for engineering).

Operationally, Turns works with e-portfolios built from simple websites. Further, she focuses specifically on portfolios consisting of a professional statement (i.e., the core of the argument), artifacts drawn from one’s experiences (think archeology), and annotations that are essentially explanations of the artifacts that provide the context and meaning of the artifact within the portfolio. In addition, she and her graduate students typically work with students in the context of a five-session portfolio studio. The studio approach helps students get support on the construction of their portfolio through instructions, the opportunity to see what others are doing, and the opportunity to get feedback on their own work.

Who Has Been Involved?

Work with Engineering Students
Over the past five years, she has worked with over 200 engineering undergraduates as they created life-wide engineering preparedness portfolios. While much of this work has been in the context of research, she has recently begun offering the portfolio studio as a 1-credit seminar.

Communication Preparedness Portfolios
Communication is a significant competency for engineers. As a result, PhD student Kate Mobrand is currently exploring multiple issues related to communication instruction by working with students on communication preparedness portfolios.

Portfolios for Co-curricular Experiences
Over the past year, Turns and her research team have worked with several groups to incorporate experience-based engineering preparedness portfolios into their activity. For example, they have been working with the
Prepared? Am I Prepared
Preparedness Portfolios & Portfolio Studios

university’s co-op office to recast a required final report in the form of this type of portfolio. In the spring, they helped a group of educators exploring a novel experience (a seminar plus leadership opportunities associated with bringing diversity issues into engineering education) to incorporate culminating portfolios into that experience. More recently, over the summer, they worked with a group that coordinated summer research experiences for undergraduates (REUs) at the University of Washington—they added a portfolio as a culminating requirement.

Portfolios for Significant Competencies
In addition to their work on communication (mentioned above), they are also exploring connecting the competency-based engineering preparedness portfolio idea to the competencies of leadership and innovation. In the case of leadership, they worked with a group on the campus that is helping students develop leadership skills. In the case of innovation, they are currently exploring this concept with a group of interested educators.

Portfolios for Graduate Students
While the bulk of their work has been with engineering students focused on making arguments about their preparedness for engineering, they have been hypothesizing that the approaches can be extended beyond undergraduate students and beyond engineering. To that end, they have conducted two studios in which they used the same curriculum to help graduate students construct a portfolio of their choosing. Of the 11 students who participated in the studios, 7 focused on building a general professional portfolio, 2 constructed teaching portfolios, 2 constructed research portfolios, and all were pleased with the experience. The completion of these studios lends credence to the idea that the preparedness portfolio and portfolio studio concept is quite adaptable.

What Are We Learning?
As mentioned above, the research involves trying to broadly and deeply understand the educational significance of asking students to create these types of portfolios. To do this, they interview students about their experiences, ask them to complete surveys further capturing aspects of their experiences, observe them during the portfolio sessions, and analyze the portfolios that they produce. The themes that students have been exploring are exhibited in the titles of their recent papers (many of which feature quotes from students):

- “I have never spent time to think about what I have gained from my projects.”
- The Dialectics of Goal Setting: Two Students’ Experiences with Portfolio Construction.
- Revisiting Communication Experiences to Prepare for Professional Practice.
- From fragmentation to continuity: Engineering students’ narratives about the benefits of developing a professional portfolio.
- Engineering Identity and Portfolio Construction.
- “This is my chance to connect”: Preparedness Arguments and Portfolio Construction.
- “I thought this was going to be a waste of time”: Using portfolio construction to support reflection on project-based experiences.
- “I just thought I did insignificant tasks”: Using e-portfolios to understand Co-op and undergraduate research experiences.

Funding
This work is funded by a grant from the National Science Foundation and from an Endowed Chair position held by Dr. Jennifer Turns.

For more information about this research, visit http://www.hcde.washington.edu/turns.
Working with students in the Communicative Practices in Virtual Workspaces lab, Dr. Mark Zachry, Associate Professor, Department of Human Centered Design & Engineering, oversees projects investigating emergent uses of digital technologies to coordinate work activities. These projects seek to understand how people act and interact through digital technologies, developing tools to understand such activities and informing the design of new systems. The investigations focus specifically on how individuals engaged in varied forms of knowledge work (e.g., engineers, technologists, project managers) use online systems to work together.

Social Translucence in Online Environments
Working with students and University of Washington colleagues in the Information School (David McDonald) and Department of Computer Science and Engineering (Alan Borning), Zachry is developing a system that enables users of massive online contributor systems like Wikipedia to understand other users through system-embedded visualizations of those other individuals based on their history of activities in the system itself. Such a system, supporting social translucence in online work environments, is designed to support more productive collaboration by helping people identify valuable contributors. This work is sponsored by the National Science Foundation.

Working on the Web
In studies of how knowledge workers use the web, Zachry and his students conduct investigations that reveal the emerging patterns of work in new, digital environments. Studying how people work toward common ends through such environments as chat systems, file sharing tools, collaborative authoring and editing forums, and similar web-based applications, the lab develops knowledge to support the design of flexible, distributed work. Primary research projects in this area include a longitudinal study of uses of online web services and the development of a system to support sensemaking about participants in massive online contributor environments.

Networked Knowledge Workers on the Web
In this project, Zachry and his students conduct an annual, national survey (starting in 2008) of knowledge workers that examines usage of publicly available online services, such as WebEx, Flickr, and Twitter, for work purposes. The project offers a view of types of online services used in rapidly changing patterns of contemporary work. The annual snapshot of web-based knowledge work articulates the changing relationship between different application types and classes of work activities.

Sensemaking about Online Interactions
In virtual workspaces, which are often geographically distributed and populated by large numbers of interactants, researchers and designers have difficulty arriving at principled understandings of the work people
Practices in Virtual Workspaces

Visualizing Mediation in Work Activities
GEMviz is a tool for researchers to translate data about communicative behaviors of a group of interactants into rule-based models. Such models allow for comparison of multiple interaction episodes, providing analysts with insight into work patterns.

For more information about this research, visit http://www.hcde.washington.edu/zachry.

Qbox is a flexible tool to support traditional and innovative forms of analysis for web-based and digital material.

are engaged in. Such knowledge, however, has great potential value for the development of new interaction technologies that could harness the potential contributions of people organized in more intelligent, appealing forms of computational work. To aid in the process of understanding online interactions, Zachry and his students have developed tools like Qbox and GEMviz.

Collaborative Coding of Digital Artifacts
Qbox is a flexible tool to support traditional and innovative forms of analysis for web-based and digital material. Qbox integrates three functional areas of work associated with content analysis: consolidating and presenting source data, performing coding or classification work, and analyzing data. QBox has been used to conduct studies such as an examination of interaction behaviors in collaborative editing and the classification of web-based technologies.
HCDE Academic Programs
The Department of Human Centered Design & Engineering offers seven different academic programs:

- Bachelor of Science in Human Centered Design & Engineering
- Master of Science in Human Centered Design & Engineering
- PhD in Human Centered Design & Engineering
- Interdisciplinary Master of Science in Technical Japanese
- Certificate in Technical Writing and Editing
- Certificate in User-Centered Design
- Certificate in Global Technology & Communication Management

These programs give students the opportunity to pursue areas of specialization, attend classes while working, or earn a degree in the evening. As part of the College of Engineering, students in HCDE receive a strong foundation in math and science, which is increasingly important in industry. The department itself offers a wide range of courses. Class sizes are small, and students work closely with faculty members and with other students.

HCDE offers students specialized learning-through-design projects and internships, in which students work with a client to design and deliver a product. HCDE also offers a directed research program in which students work in small teams with faculty to do hands-on research and often publish the results.

Degree Programs
The Bachelor of Science in Human Centered Design & Engineering gives students strong communication and design skills, coupled with a substantial basis in engineering fundamentals, math, and science. Students learn about technical discourse, human-computer interaction, hypermedia and multimedia, publications management, and online support systems. Undergraduates also build skills necessary to design, write, edit, and evaluate technical and scientific materials. Graduates apply their knowledge to create and enhance communication in scientific and technical environments.

The Master of Science in Human Centered Design & Engineering advances students' knowledge and skills in the design and evaluation of information products, technologies, and user interfaces. The MS curriculum, offered in the evening to accommodate both full time and part time students, helps students refine their skills in the design, production, and evaluation of technical information. In addition to cutting-edge coursework, students may work in directed research groups, conducting research with faculty on research and real-world projects.

The PhD in Human Centered Design & Engineering provides unparalleled depth and experience for students interested in studying the conception, design, implementation, usability, and evaluation of technologies for specific audiences or user groups. In addition to learning through relevant and contemporary coursework, students work closely with faculty on real-world projects and research questions.

The Interdisciplinary Master of Science in Technical Japanese is a two-year degree program that combines the study of one of ten engineering disciplines at the University of Washington and Japanese. Students learn to read Japanese technical journals, give research presentations in Japanese, and communicate effectively in a Japanese work environment.

Certificate Programs
The HCDE User-Centered Design (UCD) Certificate is an evening graduate-level program for students who want to explore issues in usability and user-centered design.

The Global Technology & Communication Management (GTCM) Certificate is an evening graduate-level program for students who want to master management challenges in localization.

The Technical Writing and Editing (TWE) Certificate is an evening program for students who want to learn practical applications and fundamental concepts in technical communication.

For more information about HCDE degree programs, visit http://www.hcde.washington.edu.
Corporate Affiliates Program
The HCDE Corporate Affiliates Program is designed to enhance interaction between industry partners and HCDE. Affiliates enjoy a special connection with HCDE that fosters long-term relationships, leading to technical exchange, collaboration, and interaction with faculty, students, and alumni.

Corporate Affiliates receive exclusive access to a generous package of benefits:

- Attendance at the annual Corporate Affiliates Day on the UW Seattle campus, including the following activities:
  - In-depth research presentations and demonstrations by faculty and students on current work.
  - Access to recruit students and alumni at the HCDE Career Fair.
  - Opportunities to host individual interview sessions with prospective employees on the UW campus.
  - Access to hold recruitment/interview sessions with HCDE students/alumni on campus at other times in the year.
  - Ability to post job openings on HCDE’s AfterCollege.com web page for free (non-Affiliates must pay a fee to post job openings).
  - Access to online resumes submitted by HCDE students/alumni at all degree/program levels.
  - Invitations to seminars, workshops, and other events of interest held on the UW campus.
  - Interaction with other industry members.
  - Access to summaries of research activities in the department.

In addition, HCDE also works with Affiliates to identify opportunities to pursue sponsored research collaborations beyond the scope of the Corporate Affiliates Program. The affiliate relationship can also become a mechanism for arranging faculty presentations at the affiliated organization as well as faculty participation in symposia and problem-solving sessions. Opportunities also exist for Affiliate representatives to present guest lectures in HCDE classes and at other forums.

Membership in the HCDE Corporate Affiliates Program requires a qualifying contribution to the department. Contributions are used to further the overall efforts of HCDE at the discretion of the Chair.

For more information about the Corporate Affiliates Program visit http://www.hcde.washington.edu/cap, or contact us at hcdecap@uw.edu.
HCDE Faculty

Faculty

**Cecilia Aragon**, Associate Professor  
PhD, University of California, Berkeley

**Cynthia Atman**, Professor  
PhD, Carnegie Mellon University

**David Farkas**, Professor  
PhD, University of Minnesota

**Mark Haselkorn**, Professor  
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**Julie Kientz**, Assistant Professor  
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**Beth Kolko**, Professor  
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**Charlotte Lee**, Assistant Professor  
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**Sarah Pérez-Kriz**, Assistant Professor  
PhD, University of California, Santa Barbara

**Judy Ramey**, Professor  
PhD, University of Texas

**Jan Spyridakis**, Professor and Chair  
PhD, University of Washington

**Michio Tsutsui**, Professor  
PhD, University of Illinois, Urbana-Champaign

**Jennifer Turns**, Associate Professor  
PhD, Georgia Institute of Technology

**Mark Zachry**, Associate Professor  
PhD, Iowa State University

Research Area

**Cecilia Aragon**: Human-computer interaction in scientific collaborations; eScience; visualization; visual analytics; eye tracking.

**Cynthia Atman**: Engineering education; engineering design learning; students as emerging professionals; education research to improve learning.

**David Farkas**: Information design with a special focus on innovative documents for 21st century literacies; software user assistance; problems in slideware design.

**Mark Haselkorn**: Strategic management of information and communication systems; risk and resilience; safety and security systems; visual analytics.

**Masashi Kato**: Technology enhanced language learning; second language acquisition; sociolinguistics; international communication.

**Kerrie Kephart**: Engineering communication; engineering education; language and learning; disciplinary learning in a second language.

**Julie Kientz**: Human-computer interaction; human-centered computing; supporting record-keeping and reflection; computing for healthy living and learning.

**Beth Kolko**: Design for digital inclusion; computer-mediated communication; educational/business/social gaming; information technology.

**Charlotte Lee**: Computer supported cooperative work; human-computer interaction; science and technology studies; design processes.

**Sarah Pérez-Kriz**: Human-robot communication; robots in mass media; visual communication & science graphics; quantitative/experimental methods.

**Judy Ramey**: User research and usability research methods (e.g., experience sampling, eye-tracking); the mobile user experience.

**Jan Spyridakis**: The effect of information design in online spaces on the user experience; remote user assessment methods; international communication.

**Michio Tsutsui**: Technology-enhanced language learning; second language acquisition; Japanese linguistics; international technical communication.

**Jennifer Turns**: User-centered design; design processes and strategies; human-computer interaction; engineering education; educating reflective practitioners

**Mark Zachry**: Human-computer interaction; workplace studies; communication design in organizations; rhetoric of technology.
HCDE Research Laboratories

The Department of Human Centered Design & Engineering supports 12 laboratories, listed below:

**The Communicative Practices in Virtual Workspaces Laboratory**
Directed by Dr. Mark Zachry

**The Computer Supported Collaboration (CSC) Laboratory**
Directed by Dr. Charlotte Lee

**The Computing for Healthy Living and Learning (CHiLL) Laboratory**
Directed by Dr. Julie Kientz

**The Design for Digital Inclusion (DDI) Laboratory**
Directed by Dr. Beth Kolko

**The Human-Robot Communication Laboratory (HRCL)**
Directed by Dr. Sarah Pérez-Kriz

**The Internet-Based User Experience Laboratory (IBUXL)**
Directed by Dr. Jan Spyridakis

**The Laboratory for Usability Testing and Evaluation (LUTE)**
Directed by Dr. Judith Ramey

**The Laboratory for Human-Centered Engineering Education (LHCEE)**
Directed by Dr. Jennifer Turns

**The Pacific Rim Visualization and Analytics Center (PARVAC)**
Directed by Dr. Mark Haselkorn

**The Scientific Collaboration and Creativity (SCC) Laboratory**
Directed by Dr. Cecilia Aragon

**The Center for Engineering Learning & Teaching (CELT)**
Directed by Dr. Cynthia Atman

**The Technical Japanese Laboratory**
Directed by Dr. Michio Tsutsui

HCDE Staff

Gian Bruno, Director of Student Services
Patty Foster, Grants Coordinator
Anne Hilton, Communications Manager
Julianna Jones, Assistant to the Chair
Allen Lee, Fiscal Specialist
DJ Miller, Administrator
Stephanie White, Academic Advisor
Lisa Yamasaki, Administrative Assistant

About *Explorations*

The cover of *Explorations 2011* was designed from a photo taken of Sieg Hall by Julianna Jones.

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