Siebel Center for Design
College of Education Synergy Document

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The College of Education (COE) recognizes the opportunity for multifaceted synergies with the upcoming Siebel Center for Design and the Design Initiative at Illinois, with “design thinking” as a key learning outcome. Following a COE meeting with the Design Initiative’s Executive Committee on December 5th 2016, this document collects together a catalogue of COE interests and synergies, including over a dozen design-related courses taught in the college.

College of Education in a Nutshell

- 65 tenure track faculty across four departments of *Educational Psychology, Curriculum & Instruction*, *Educational Policy, Organization & Leadership*, and *Special Education*.
- Active in research with funding from NSF, NIH, IES (research arm of the Department of Education), as well as state and foundation grants.
- Historical leadership role in Online Teaching and Learning, Special Education, Reading, Literacy, Early Childhood Education, Mathematics ("New Math"), Educational Policy, Educational Evaluation Theory and Practice, Higher Education Outcomes Assessment, Diversity and Educational Reform.
- Maintains deep relationships with local school districts, Illinois community colleges, state agencies, national disciplinary bodies, and museums.
- Main building located at 6th and Peabody, opposite from Siebel Center of Design site.

Key Principles for Design

- **Learning** is a multimodal endeavor; the socio-cultural, physical, cognitive, affective, and technological aspects of a learning environment all need to be considered in the design process.
- **Design Processes**, by nature, are also learning processes (learning through systematic exploration and discovery).
- **Learner Variability** requires critical planning to proactively consider how to provide and integrate more inclusive and accessible technologies that are accessible to all people, including those with disabilities.
- **Pedagogy** is always a process of learning-by-design that includes both formal and informal learning.

- **Social Processes.** The social component of design becomes visible when we acknowledge the provenance of design elements, when we keep a record of systematic peer and teacher review, and when we undertake impact/stakeholder analyses recognizing perspectives other than the designer's. It is only meaningful to its stakeholders when its values can be articulated through consistent, systematic and culturally responsive/relevant processes.
- **Constituents** should be recognized and acknowledged explicitly, in order to ensure that roles, contributions, and benefits are accounted for in both structure and process.
- **Collaboration**, inclusive and managed, should be implemented, and broad, among all constituents, including university faculty, students, community members, K-12 teachers and students, and others. Projects could include K-12 collaborators as contributors to research knowledge as well as recipients of that knowledge.
- **Designed Objects** do not immediately reveal the processes of their making (including for example their purposes, elements sourced from antecedent designs vs. innovative elements, and the range of their effects). Designing-as-process is ephemeral.
- **Design Outcomes** are supported by design activities that are deeply rooted in design thinking, which varies from discipline to discipline and context to context. It is crucial for Design-Based Learning (DBL) to afford not only tangible design skills, but intangible design thinking that can be transferred from school settings to workplaces.
- **Innovation Through Design-Based Research**. Innovations to solve real-world educational problems require substantial design efforts and rigorous inquiry simultaneously. Strong collaboration with practitioners, thorough understanding of the context, and integration of theoretical grounds are crucial for conducting Design-Based Research (DBR). Iterative DBR process helps the refinement of a mature intervention, as well as identification and fine-tuning of design principles.
- **Design Evaluation**. Evaluation processes and learning processes should be co-designed in parallel. Evaluation should be culturally responsive and relevant, aligned with the expectations and needs of diverse populations and stakeholders.

Suggested Principles to Create and Organize the Center for Design

- **Advancing Design-Based Thinking Skills Through Research:** How best to motivate, scaffold, and assess design-based thinking skills represent some of the most important and relevant education research questions of the 21st Century. The COE would embrace the opportunity to advance these important questions in conjunction with the Siebel Center of Design, which would simultaneously advance the goals of the center and advance research on the psychology and learning of design skills.
- **Providing Scaffolding and Supports for Design-Based Learning (DBL):** Strategies to foster in-class DBL outcomes are important. More importantly, with "design thinking" as the key learning outcome in mind, we could create scaffolding structures/processes at the Center-level with DBL course map to enrich students' DBL experiences and systematic evaluations to demonstrate DBL's values for parents, the state, and industry partners.

- **Calibrating the Mix of Education Activities:** Design education activities will require a carefully calibrated mix of openness and scaffolding (the pedagogical component in this mix).
- **Acknowledging Center Constituents:** Well-integrated and planful Center function needs the explicit acknowledgment of both proximal and extended constituents, including university faculty, students, community members, K-12 teachers and students, and others.
- **Designing for Learner Variability:** Designing for learner variability, at its core, involves acknowledging that digital tools, content, and other technologies should be designed for all people, including those with disabilities and other challenges that might limit their access or participation. To actualize this mission of access for a broad range of users, research is needed into what barriers exist within different technology platforms, for whom, and under what contexts. It also requires advancing our understanding of how to address those barriers as technologies continue to evolve.
- **Supporting the Center as a Network:** The initiative is more than just a building—it is a network. The facility and design choices should support convenient (just-in-time) and robust virtual presence of expertise from around campus and around the world. It should be recognized as a place that will serve to convene and expand action research projects locally, statewide, nationally and indeed internationally.
- **Facilitating Research Data Collection:** The building and the instructional/learning processes used should be designed to include features that facilitate data collection for evaluation, assessment and learning research, including the iterative design process that includes revision of interventions and products that are inherent to the DBL process.
- **Documenting Instruction and Assessment Systematically:** For the purposes of instruction and assessment, design processes, products, and stakeholder outcomes, will all require systematic documentation. In the era of web-enabled learning, this documentation can take the form of "multimodal knowledge representations" — alphabetic/symbolic, image, sound.
- **Assessing Social and Cultural Aspects of Design:** The social and cultural aspects of design also need systematic documentation, essential to have sufficient data for valid and reliable assessment.

Relevant Design-Centered Learning Instruction Delivered by COE

Courses which contribute to students' understanding and practice of design thinking, problem framing, analytical reasoning, ideation and conceptualization, prototyping and communication include:

- CI 437 — *Educational Game Design (Lindgren)* combines industry design and development practices with theories of how people learn to develop engaging game environments that cultivate new knowledge and skills in their players. Students in this course create prototypes of both physical and digital educational games.
- CI 489—*DELTA Capstone Course (Mercier)* focuses on a participatory design project for educational technology. Students work in teams, in collaboration with a teacher or other educator, to create and test technology with learners. Aligning technology with

pedagogy, and iteratively designing with and for learners and teachers, are key features of this course.

- EPOL 350 — *Social Knowledge and Learning [to be offered starting in 2017]* exposes students to the changing landscape of knowledge and learning through a hands-on experience of collaborative knowledge production and learning. Issues and concepts to be addressed include Web 2.0, participatory media, peer-to-peer knowledge networks, 'the commons', informal online learning, and the dynamics of formal e-learning ecologies.
- EPSY 456/ISE 445 — *Human Performance and Cognition in Context (Morrow)* considers how understanding our perceptual and cognitive strengths and limitations can inform decisions about education and training strategies, as well as designing technological environments to suit our needs and abilities. The course also considers methodologies for assessing human performance in different contexts. Concepts are illustrated using examples from transportation (aviation and driving), medical, and education domains. Design and training implications of individual differences in cognitive abilities are also explored by examining the impact of aging on user abilities.
- EPSY 490 — *Learning in Everyday Contexts (Lane)* covers aspects of learning out-of-school (museums, afterschool, at home, etc.). A significant portion of the course is devoted to the design of informal learning experiences, such as exhibits found in science museums.
- EPSY 590 — *Engaging and Interactive Educational Technologies (Lane)* focuses on the intersection of entertainment technologies and education. Employing effective practices from both communities, students participate in semester-long, team-based interdisciplinary projects to produce prototypes that address both learning and affective outcomes. The course culminates in a day of demos open to the public.
- HRD 411 — *Training System Design* articulates fundamentals of human learning, introduces design models and processes, and develops design thinking.
- HRD 470 — *Design of Learning System* introduces organizational learning systems and contexts, develops skills for developing tangible learning systems, and develops design thinking that connects individual learning with organizational performance.
- HRD 472 — *Learning Technologies* surveys current technological applications for learning, designs technology-enabled learning systems, and develops design thinking for technology-enabled learning.
- HRD 533 — *Management of Learning Systems* introduces methods to manage learning system design projects and develops design thinking considering organizational resources.
- HRD 575 — *Innovations of E-Learning* focuses on learning system and technology integration into organizations and introduces organizational learning opportunities and barriers to learning system design thinking.
- HRD 585 — *Training and Educational Program Evaluation* introduces systematic evaluation methods to verify the value of learning system design, develops design thinking that incorporates stakeholders' needs and perspectives, and develops skills to collect, analyze, and interpret evaluation data, in order to improve learning system design.

Relevant Resources and Expertise at COE

1. **The Digital Environments for Learning, Teaching, & Agency (DELTA) undergraduate and graduate programs** focuses on the creation and research of digital environments for learning and teaching. This includes technology-enhanced classrooms, mobile devices, and immersive simulations across a range of disciplines, for both formal and informal settings.

   Link: http://publish.illinois.edu/deltaprogram/

2. **The Illinois Learning Sciences Design Initiative (ILSDI)** is a campus-wide activity led from the COE which aims to build, synthesize, translate, and apply theories of learning to guide designing, building, trialing, assessing, scaling, disseminating, and commercializing evidence-based, replicable, cutting-edge, and transformational technological tools, solutions, and platforms in support of learning environments and practices.

   Link: http://education.illinois.edu/associate-dean-for-research/strategic-initiatives/illinois-learning-science-design-initiative

3. **Illinois Digital Ecologies Learning Laboratory (IDEALL)**: A cutting-edge facility located in the College, IDEALL serves as a blank-slate data collection environment, providing the infrastructure for fine-grained research on learning with emerging technologies. It:
   a. Enables scholars to study learner interactions with digital technologies in real-time;
   b. Allows investigators to create technology-enhanced learning environments, and research their impact on student learning; and
   c. Collects massive and varied data about learner-technology interactions, including movements and discourse.

   Link: http://education.illinois.edu/ideall

4. **The Learning Design and Leadership Program:** A series of 400 and 500 level courses that address the principles and practices of pedagogy as a design process. Their particular focus is on technology-mediated learning. Although these courses are designed for graduate study (certificate and masters), undergraduates may also join. From 2017, we will also be offering the course, EPOL 350 Social Knowledge and Learning (see course description above).

   Link: http://education.illinois.edu/online-offcampus/programs-degrees/ldl-online

5. **Scholar:** A “social knowledge” platform supporting project based learning and peer review, Scholar was created with the support of grants from the Institute of Education Sciences, the National Science Foundation, and the Bill and Melinda Gates Foundation. It is licensed by Common Ground Research Networks NFP, and is based in the Research Park.

   Link: http://cgscholar.com

6. **Center for Culturally Responsive Evaluation and Assessment (CREA):** CREA serves as a vehicle to engage in methodologically rigorous evaluation, assessment and research to meaningfully address a range of educational (K-16), social service, and health service programs that serve low-income, traditionally disenfranchised and culturally diverse communities. CREA's focus on cultural responsiveness is unique in that no other university-based research center focuses on the centrality of culture and cultural context in evaluation and assessment theory and practice.

   Link: http://crea.education.illinois.edu

7. **Technology-Enhanced Learning Spaces:** The College has invested in four advanced classrooms in the Education Building that reflect the expertise and experience of collaboration among our faculty, our staff, and campus. Three are iFLEX collaboration classrooms, featuring multiple interactive monitors, flexible furniture and wrap-around writing surfaces. One of the iFLEX classrooms also features a Touchscreen Interactive video wall, and two built-in cameras.

   Link: http://education.illinois.edu/techservices/support-for-teaching-and-learning

8. **Learning System Design and Evaluation Course Sequence:** A list of 400 and 500 level Human Resource Development (HRD) courses, shown in the section above, to develop students' design skills and design thinking for designing learning systems that improves learning and performance outcomes for individuals and organizations. The contexts that situate these design activities may vary as learning and performance issues are ubiquitous across industry sectors and organizations. The course sequence also emphasizes the implementation and evaluation of learning systems as design outputs by considering organizational cultures and their incentive structures.

   Link: http://catalog.illinois.edu/courses-of-instruction/hrd/

9. **The Applied Learning Sciences (AppLeS) undergraduate program** is an interdisciplinary concentration of the Learning and Education Studies major in which students acquire flexible learning and problem solving skills that can be broadly applied to diverse contexts. The program draws on progress in the learning sciences toward identifying general principles of learning and understanding how these principles can be applied in the classroom as well as at work, home and other contexts of daily life.

   Link: http://education.illinois.edu/programs/undergrad/programs-degrees/les-apples-ug

10. **Office for Mathematics, Science, and Technology Education (MSTE)** is a community of practice that functions as a bridge among other such communities–promoting collaboration between widely dispersed academic researchers, K-12 school teachers, administrators and students at all levels, as well as supportive interactions with a board of experienced advisors.

    Link: http://mste.illinois.edu/

11. **Impact on Science Education** is a collaborative of science education projects from across the University of Illinois campus and UIUC Extension that link university scientists, engineers, teacher educators with schools from across Illinois and the broader US, working to collaboratively develop innovative curriculum and professional development aligned with current reforms in science education.

    Link: http://impactscied.illinois.edu/

12. **100Kin10 Build The Movement Partner:** The College of Education is working to disseminate and facilitate the sharing of our research findings that focus on STEM teaching and learning with the larger 100Kin10 organization and teacher education.

    Link: https://100kin10.org

Opportunities for New Initiatives

A close connection between the Siebel Center for Design and the College of Education should motivate and facilitate new projects and initiatives, such as:

- Data collected at the Siebel Center for Design could be analyzed in research projects undertaken at COE, with results potentially feeding back into improving instruction and learning.
- Possible projects that bring together the Siebel Center for Design and College of Education around the emerging focus on design thinking in K-12 schools: *Taking Design Thinking to School: How the Technology of Design Can Transform Teachers, Learners, and Classroom*.
- Building out the "Center for Design Network" by establishing connections throughout campus–establishing "portal"-enabled video surfaces in the Design Center and other buildings throughout campus.
- Design-Based Learning (DBL) curriculum development experimentation/contest for the entire campus.
- "Learning with Design Thinking" initiative to introduce various design thinking from one discipline to another, from one context to another.
- Design-based Research (DBR) that introduces participatory strategies to garner buy-in from all stakeholders in order to sustain the impact of design outputs.
- Data can be collected on projects undertaken by the Center that focus on traditionally underserved and underrepresented communities to determine the extent culture and cultural context are considered.
- Data can be collected on Center projects that have a significant focus or participation of underrepresented minorities (URMs) and/or women.

Interested Faculty and Researchers

- Gabrielle Allen, Professor, Educational Administration, COE Associate Dean for Research. Ph.D. in Computational Astrophysics. Research interests: scientific software development to support collaborations, open science.

- Bill Cope, Professor, Department of Education Policy, Organization and Leadership. Research interests: computer-mediated learning, multimodal literacies, pedagogy as a design process, project-based learning. He leads the team that has developed the e-learning platform, Scholar.
- Stafford Hood, Sheila M. Miller Professor of Education, Professor of Curriculum and Instruction & Educational Psychology, and Founding Director of the Center for Culturally Responsive Evaluation and Assessment (CREA). Research interests: importance of culture/cultural context in program evaluation, educational assessment, and computer based instruction & assessment.
- Wenhao David Huang, Associate Professor, Department of Education Policy, Organization and Leadership. Ph.D. in Learning, Design and Technology. Research interests consist of developing transferrable design thinking for adult learners, emotional design, multimedia learning scaffolding and engagement, learning and performance incentive system design, learning system evaluation, and implementation of design artifacts/outputs.
- Barbara Hug, Clinical Associate Professor Department of Curriculum and Instruction. Ph.D. in Developmental Biology and Genetics. Research and design interests: K-12 curriculum design and professional development for K-12 science teachers.
- Maya Israel, Assistant Professor, Department of Special Education. Ph.D. in Special Education. Research interests consist: design and development technologies and instructional strategies to support struggling learners and students with disabilities in science, technology, engineering, and mathematics (STEM) with a focus on computer science and computational thinking.
- Mary Kalantzis, Professor, Department of Education Policy, Organization and Leadership. Research involves conceptualizing the nature of communication and learning in the digital age, focusing on the policy, practice and pedagogical design implications of new technologies in education. from early childhood to higher education.
- H. Chad Lane, Associate Professor, Department of Educational Psychology. Ph.D. in Computer Science. Research involves the design, use, and study of intelligent technologies for learning and behavior change. This work involves blending techniques from the entertainment industry (that foster engagement) with those from artificial intelligence and intelligent tutoring systems (that promote learning), as well as running studies to better understand whether and how the resulting learning experiences impact learners.
- Robb Lindgren, Assistant Professor, Department of Curriculum & Instruction, Ph.D. in Learning Sciences and Technology Design. Research and design interests: new technologies for learning in the STEM content areas. He is particularly interested in the perceptual and physical affordances of interactive and immersive science visualizations.
- Emma Mercier, Assistant Professor, Department of Curriculum & Instruction, Ph.D. in Educational Psychology. Research interests: the role of social interaction in learning and computer-supported collaborative learning in classrooms. She has designed and studied collaborative activities for classrooms and focuses on understanding how group interactions lead to learning. She has also taught and studied participatory, interdisciplinary design processes and project-based classes.

- Dan Morrow, Professor and Chair, Department of Educational Psychology, Ph.D. in Cognitive Psychology. Research interests include life-wide learning (beyond the traditional classroom) and lifelong learning. Life-wide learning becomes increasingly important over the lifespan as experiences at work and elsewhere become more diverse, and as health becomes a greater challenge with increasing need for learning new concepts and skills related to health. Dan and his collaborators investigate how to improve patient self-care, often by leveraging technology advances.
- Eunjung Grace Oh, Assistant Professor, Department of Education Policy, Organization and Leadership, Ph.D. in Learning, Design and Technology. Research interests include design of online and technology-enhanced learning environments to enhance learning, engagement and critical thinking of adult learners, educational design research, and different generational groups of workforce in their learning, career preparation, and use of technology.
- Luc Paquette, Assistant Professor, Department of Curriculum & Instruction, Ph.D. in Computer Science. Research interests include the usage of Educational Data Mining and Learning Analytics approaches to build model of student behaviors as they interact with their learning environment and to study the relationship between those behaviors and learning outcomes.
- George Reese, Director, Office for Mathematics, Science, and Technology Education (MSTE). Ph.D. in Mathematics Education. Current research interest is connecting new digital technologies to existing STEM content areas, especially mathematics.

References

Impact of Diagrams and Visualizations of Phenomena

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    - In multimedia learning theory, Mayer is one of several theories of instructional design that argue that the manner in which diagrams and other visualizations of phenomena used to convey core concepts and critical ideas in curriculum materials are constructed can have a significant impact on how and what people learn from them.
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    - Gentner & Wolff argue that metaphors transform prior knowledge into systems of ideas that are richer and more robust.

Importance of Functional Visual Representations

While the textbook production model is text-driven to an extent that inhibits the development of functional imagery, it is well-established that textual content is significantly aided by functional visual representations.

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- Tversky, B. (2011). Visualizing thought. *Topics in Cognitive Science, 3*, 499–535.

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- Vekiri, I. (2002). What is the value of graphical displays in learning? *Educational Psychology Review, 14*(3): 261–312.

Design Opportunities to Engage in Formal and Informal Learning Spaces

The need for a scientifically literate population, and a large, diverse STEM workforce that has led to the design and development of a range of opportunities for students to engage in STEM-related activities in formal and informal learning spaces.

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- Allen, S. (2004). Designs for learning: Studying science museum exhibits that do more than entertain. *Science Education, 88*(1), S17–S33.

Use of Design Research Methodology

Design research methodology aids in understanding the impact of curriculum design choices and answering research questions.

- Anderson, T., & Shattuck, J. (2012). Design-based research: A decade of progress in education research? *Educational Researcher*, *41*(1), 16–25. doi:10.3102/0013189X11428813
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Meaningful Engineering Design and Student Success

Implementing personally meaningful STEM activities projects, and ensuring all students have successful learning experiences, is not a trivial endeavor.

- Dym, C. L., Agogino, A., Eris, O., Frey, D. D., & Leifer, L. J. (2005, January). Engineering design thinking, teaching and learning. *Journal of Engineering Education*, 103–120. doi:10.1109/EMR.2006.1679078

Figurative or Linguistic Metaphor: Underlying Human Capacity for Conceptual Metaphor

Figurative or linguistic metaphor, can be recast the most traditional sense as a rhetorical trope in verbal communication, as a product of the *underlying human capacity* of conceptual metaphor, rather than as an *invented* device.

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Design-Based Learning

- Puente, S. M. G., van Eijck, M., & Jochems, W. (2013). A sampled literature review of design-based learning approaches: a search for key characteristics. *International Journal of Technology and Design Education*, *23*(3), 717–732.
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Design-Based Research

Design-based research aims to improve practices and advance theories based on a tangible learning or performance problem in a real contexts through iterative process of rigorous and reflective inquiry to design, test and refine innovative learning solutions as well as to refine reusable design principles.

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Design Thinking in K-12 Schools

- Goldman, S., & Kabayadondo, Z. (Eds.). 2016. *Taking design thinking to school: How the technology of design can transform teachers, learners, and classroom*. New York: Routledge.

Design Environments that Support Learner Variability

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Evaluation of Design Activities

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