

ILLINOIS LEARNING SCIENCES DESIGN LAB

(First Draft Concept Paper: May, 2014; Revised Draft, December 22, 2014)

“Develop a learning science laboratory to understand learning mechanisms and to invent learning and educational tools, practices, and spaces for the future of teaching and learning across disciplines and professions.”

- Visioning Future Excellence at Illinois, Outcomes Report, July 2013

Objectives

Activities of the proposed Illinois Learning Sciences Design Lab (ILSDL) include designing, prototyping, developing, trialing, assessing, scaling, disseminating and commercializing evidence-based, replicable, transformational, and cutting-edge technological platforms and tools in support of 21st century learning and teaching practices and environments. Laboratory activities will be carried out toward achieving the following primary objectives:

- **Objective I:** Draw on, synthesize, translate, support, coordinate, and/or conduct rigorous, scientific, and large-scale research on learning, which significantly contributes to the creation, development, assessment, scaling, and dissemination of educational tools and practices. The activities of the ILSDL would synergistically contribute toward refining and furthering theories of how people learn and what factors contribute to effective instruction, particularly in the context of technology-enhanced learning environments.
- **Objective II:** Design and develop cutting-edge, technology-intensive learning tools and solutions that have significant and lasting impacts on learners and instructors locally, nationally, and globally. Tools will be developed by interdisciplinary collaborations drawing on the strengths of Illinois research and faculty. Coordinated efforts of multiple entities and resources on campus (and with strategic partners) will drive these tools and solutions into online platforms, P-20 formal learning settings, informal learning environments (e.g., science centers, art museums), and the commercial marketplace. The ILSDL, it should be noted, is not aimed at providing instructional design, support, resources, and/or professional development for UIUC faculty and instructors.
- **Objective III:** Develop data analytics and data mining tools/approaches to harvest the potential of “big data” and peta-scale computing toward transforming unitary, technology-mediated instructional delivery systems into adaptive, responsive, and personalized learning environments. Specific analytic tools and approaches will be invented at the ILSDL, applied to the evaluation of the lab’s

tools/solutions and other emergent platforms, and disseminated for application in the broader design, development, and research communities.

The Illinois Learning Sciences Design Lab

The lab will bring together faculty and graduate students from across the Urbana-Champaign campus and strategic partners who are interested in designing and testing learning technologies and solutions that have transformative potential. With leadership from the **College of Education, College of Engineering, Graduate School of Library and Information Science, College of Liberal Arts and Sciences,** and **College of Fine and Applied Arts,** as well as the **National Center for Supercomputing Applications** and **Beckman Institute** this lab will merge contemporary theories of learning and development, state-of-the-art pedagogical practices, and cutting-edge technologies and design principles, toward the creation of tools aimed at optimizing human learning. The lab will provide a unique hub of activity with resources for collaboration that facilitate interdisciplinary teams of researchers, staff, and students to pursue external funding opportunities, develop prototypes and explore broad dissemination, and to conduct impactful research that challenges and transforms the status quo. A number of centers, units, and offices across campus have expressed strong interest in supporting the activities of the ILSDL as Affiliates, including Illinois Venture, Office of Technology Management, and Center for Innovation in Teaching & Learning.

Grand Challenges

The aim for the Lab is to be **distinctive** in its pursuits of technology-intensive educational innovations and tools. The areas of focus for the Lab will leverage existing research, design, and development strengths on the Urbana-Champaign campus (big data curation and high-powered computing and analytics; cutting-edge scientific, engineering, and technological capacity; cutting-edge research and deep knowledge of teaching and learning across settings and the lifespan; partnerships with local, regional, and international institutions of formal and informal learning; etc.) to address a number of timely grand challenges related to optimizing learning, with special attention to the development among learners of 21st century critical understanding, skills, competencies, and agency.

The specific areas of focus for the Lab will be shaped through ongoing discussions and a campus-wide symposium planned for Spring 2015. Examples of potential “grand challenges” that the lab could address include:

- **Designing Physical Learning Spaces of the Future:** While there is much deserved attention being given to online learning platforms, the bulk of explicit

instruction still occurs in physical classrooms and other real world educational environments. Impressive advances have been made with immersive, tangible, intelligent, and multi-user digital media systems, but more often than not, these technologies either do not find their way to the typical classroom, or are not optimally designed to support complex collaborative tasks embedded in diverse social contexts. Considerable progress can be made in addressing this challenge by combining existing Illinois expertise in sensors, augmented reality, and intelligent interfaces; and theories of cognition and learning; with pedagogical theories of collaborative, socio-cultural, and embodied learning. For example, a science classroom in middle school would be equipped with a coordinated array of media technologies including multi-touch tables, interactive wall displays, and motion sensing cameras that allow students to move around the room and execute sophisticated inquiry practices that emulate real scientists working in teams. Advanced techniques in computer vision and real-time analytics would be applied to respond to the classroom activity system and orchestrate interactions to produce effective learning conversations and coordinated investigations.

- **Curating and Analyzing Big Data to Transform Unitary Platforms into Adaptive Personalized Learning Environments:** Digital technologies have progressed to the point of being able to provide learners with highly engaging and authentic interactive experiences (serious games, augmented reality, etc.) with the associated ability to collect massive amounts of data about the choices and behaviors of an individual learner (keyboard strokes, mouse clicks, eye tracking, electrophysiology, trans-cranial direct current stimulation, body movement, etc.). Utilizing Illinois expertise in—among other domains, data curation, data mining, statistics, natural language processing, and adaptive assessment, the Lab can make substantial progress on using learner data to make meaningful inferences and provide real-time assessments that allow for adaptive and personalized learning experiences. For example, massive data on learner enrollments, engagement, persistence, click-by-click individual and group interactions, etc., within MOOCs would be ‘intelligently’ mined toward understanding and impacting factors associated with student learning within this emerging platform. Natural language processing, computational capabilities, and current theories of assessment would be harvested to provide individualized real-time and delayed feedback to the thousands of students enrolled in a specific MOOC so as to optimize their engagement, enhance self-regulation and self-monitoring, and eventually sustain their engagement and maximize their learning.
- **Broadening Participation and Deepening Identification with the STEM Areas:** There is an urgent nationwide need to recruit more students into the STEM

disciplines (Science, Technology, Engineering, and Mathematics), especially amongst historically underrepresented populations, such as women and minorities. This issue can at least partially be addressed by giving more children exposure to STEM practices and more opportunities to identify themselves as potential STEM professionals. For example, Illinois faculty with expertise in the practice of engineers, immersive technologies, and the psychological and cultural components of identity can collaborate to build interactive experiences that change student attitudes and build feelings of efficacy that such that they transform their professional trajectory. Immersive games and simulations would be built to engage K-12 students with the types of problems faced, and solution modalities employed, by engineers. These virtual environments would have engineering expertise “built-in” so that the students are guided—through adaptive and responsive pathways, in their approaches to the problems and the design of possible solutions. Students using these games would be assessed both in terms of engineering knowledge and practices gained, as well as changes to their attitudes towards the STEM disciplines and the likelihood of pursuing STEM-related careers.