Moving forward: The learning sciences and the future of education

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Abstract. In Spring 2006, The Cambridge Handbook of the Learning Sciences (CHLS) was published. CHLS is the first introduction and handbook of the learning sciences, and combines breadth of coverage with definitive statements by leading scientists working in the learning sciences. As such, it is an important milestone for the field. In this interactive session, the handbook’s four advisory board members and its editor, along with the session participants, will explore two sets of questions that were raised during the preparation of the CHLS, and which to some extent remain unresolved. The first is inward—how to define the learning sciences, and how it is intellectually structured. The second is outward—how the learning sciences might impact education in the years to come.

Learning sciences was born in 1991, when the first international conference was held, and the Journal of the Learning Sciences was first published. The National Research Council report How People Learn (Bransford, Brown, & Cocking, 2000) was the first overview of the new sciences of learning. That book provided an accessible introduction to the learning sciences for a broad audience. In Spring 2006, The Cambridge Handbook of the Learning Sciences (CHLS) was published. The Cambridge Handbook of the Learning Sciences (CHLS) picks up where the NRC report left off: CHLS shows how educators can use the learning sciences to design more effective learning environments—whether school classrooms, informal settings such as science centers or after-school clubs, on-line distance learning, or computer-based tutoring software. CHLS is the first introduction and handbook of the learning sciences, and combines breadth of coverage with definitive statements by leading scientists working in the learning sciences. As such, it is an important milestone for the field.

In this interactive session, the handbook’s four advisory board members and its editor, along with the session participants, will explore two sets of questions that were raised during the preparation of the CHLS, and which to some extent remain unresolved. The first is inward—how to define the learning sciences, and how it is intellectually structured. The second is outward—how the learning sciences might impact education in the years to come.

Overview of the Cambridge Handbook of the Learning Sciences

The 34 chapters of the CHLS are organized into six parts.

The editor’s Introduction and Conclusion explain why the learning sciences are important not only to education, but to our entire society. The major advanced nations and the entire global economy are rapidly changing. These two chapters draw on a large body of recent scholarship that describes the mismatch between the schools we have today and the demands of the knowledge age. Because the learning sciences are discovering how to teach the deep knowledge, skills, and attitudes required in the knowledge society, they are positioned to provide the blueprint for the schools of the future.

Part 1, Foundations, introduces the reader to many of the big ideas that have been most influential throughout the learning sciences. Part 1 contains chapters on interdisciplinarity, constructionism, cognitive apprenticeship, cognitive tutors, situativity, and knowledge building.

Part 2, Methodologies, describes the unique research approaches used by learning scientists to study and to design new learning environments. Experiments are an important research methodology, but they are typically not useful in designing and engineering classrooms, and learning scientists have developed a variety of new methodological tools. Part 2 contains chapters on learner-centered design, design studies, design-based research, guiding inquiry-based learning, analyzing collaborative discourse, and assessing for deep understanding.
Part 3, The Nature of Knowledge, presents new research on the kinds of deep knowledge that support expert activity. Learning scientists are not simply trying to help students memorize textbook facts better, because memorizing isolated facts and step-by-step procedures is not enough in today’s knowledge society. Instead, learning scientists study how to help students understand underlying explanations and causes, and how to solve complex, real-world problems. Part 3 contains chapters on case-based reasoning, knowledge integration, conceptual change, spatial representations and imagery, and literacy.

Part 4, Making Knowledge Visible, shows how learning scientists are using these new discoveries about the nature of knowledge to design classroom activities that help students learn by making visible the deep knowledge they need to learn—often with sophisticated computer displays. Part 4 contains chapters on project-based learning, making authentic practices accessible to learners, developing curricular structures for inquiry science, model-based reasoning, and exploring mathematics through construction and collaboration.

Part 5, Learning Together, emphasizes the important role of collaboration in learning. A wide range of educational research has found that collaboration contributes to learning. Unlike an older generation of educational software, where each student worked in isolation at his or her own computer, the advent of the Internet and of wireless handheld devices supports students in learning collaborations, so that computers bring students together instead of pulling them apart. Part 5 contains chapters on computer-supported collaborative learning, wireless handheld devices, argumentation, and online communities.

Part 6, Learning Environments, tackles the real-world problems that face any educational reform—teacher professional development, equity for all students, and scaling up innovations throughout school districts and ultimately, throughout the country. Part 6 contains chapters on motivation and cognitive engagement, learning as a cultural process, transforming schools with technology-supported assessment, Internet use in schools, teacher learning research, and scaling up.

Two short essays follow the editor’s Conclusion: an Afterword by Seymour Papert titled “After how comes what”, and an Epilogue by Roger Schank titled “The fundamental issue in the learning sciences”.

Session objectives

The objectives of the proposed ICLS session are to bring together the contributors to the CHLS, other scholars in the learning sciences community, and a broad audience of ICLS members who are interested in participating in a wide-ranging discussion about how the learning sciences defines itself at this point in its history, and how the learning sciences can and should contribute to improving education in the next decade.

The first questions focus inward, on the learning sciences itself. In preparing the handbook, difficult decisions had to made about which chapters to include. A second difficult issue was how to structure the handbook into its six parts, which essentially represent one version of the epistemology of the field—how it is divided up intellectually into research questions. The five session participants had many discussions about both which chapters to include, and how to structure the handbook. The particular representation of the learning sciences captured in the CHLS is one of many potential representations, and in this session its structure will provide a “tool to think with” about these unresolved questions. What defines a research project as being “learning sciences”? Breaking down boundaries is always appealing, but without boundaries, potentially all education research would count as learning sciences. And most members of the community feel that there’s something unique and different about the learning sciences. So what defines the essence of learning sciences research? Second, what is the epistemology of the learning sciences—what are the major research topics that projects tend to cluster around? Although most of the research is on science and math learning, learning scientists generally believe that the key issues are not content-area specific—that the basic epistemological categories are cross-domain.

The second session topic will focus on outward issues. Who should be the target audience for our research? What is the appropriate scope of that audience—is it other researchers and new graduate students, or is our research ready for a broader audience? These questions about scope are really versions of a deeper question: What is the potential impact of the learning sciences on schooling? What is our vision for the future of education? How will the findings emerging from the learning sciences impact education in the future? This discussion will span across schools and also other learning environments, such as museums, libraries, apprenticeships, and on-line learning.
Instead of studying small incremental changes to today’s schools, learning scientists ask a more profound question: are today’s schools really the right schools for the knowledge society? Most learning sciences researchers are committed to improving schools, and they believe that school reform should involve working together with teachers, engaging in professional development, and integrating new software into classrooms. But learning sciences research might also lead to more radical alternatives that would make schools as we know them obsolete. Roger Schank and Seymour Papert have argued that computer technology is so radically transformative that schools as we know them will have to fade away before the full benefits are realized. Everything is subject to change: schools may not be physical locations where everyone goes, students may not be grouped by age or grade, students could learn anywhere at any time. As of 2005, twenty-two states had established on-line virtual schools; during the 2003-2004 school year, the Florida Virtual School became the state’s 73rd school district, and now receives per-student funding from the state just like any other district (Borja, 2005).

The future of education

The chapters in CHLS each describe exciting new classroom environments, based on the latest science about how children learn. These classroom environments combine new curricular materials, new collaborative activities, support for teachers, and innovative educational software, often using the unique advantages of the Internet to extend learning beyond the walls of the school. CHLS is a true “handbook” in that readers can use it to design the learning environments of the future—environments that are based on learning sciences research, and that draw on the full potential of computer and Internet technology to improve our students’ experiences. The learning sciences are supporting deep links between formal schooling and the many other learning institutions available to students—libraries, science centers and history museums, after school clubs, on-line activities that can be accessed from home, and even collaborations between students and working professionals.

Many of the cutting-edge classrooms described in CHLS make use of advanced computer technology—but not just for technology’s sake. Learning scientists are well aware that computers have generally failed teachers and students; that they are, in Larry Cuban’s famous words, “oversold and underused” (Cuban, 2001). Learning sciences researchers have discovered that computers only benefit learning when they take into account what we know about how children learn, and when they are designed to be closely integrated with teacher and student interactions in the classroom. Computer software is only one component of CHLS; various chapters propose new teaching strategies, alternative ways of bringing students together in collaborating groups, and new forms of curriculum that cross traditional grades and disciplines. Some chapters even propose radical new ways of thinking about schooling and learning. Many of these proposals are “outside the box” approaches that will change the way we think about learning and schooling.

In the next ten years, the task facing all knowledge societies will be to translate learning sciences research into educational practice. Perhaps the most solid finding to emerge from the learning sciences is that significant change can’t be done by fiddling around at the edges of a system that was designed in the industrial age. Instead, the entire educational system will have to be replaced with new learning environments that are based on the learning sciences. Many tasks have to be accomplished:

- Parents, politicians, and school boards must be convinced that change is necessary. The shift will require an initial investment in computers, software, and network infrastructure—perhaps even new buildings with as-yet-undetermined architectural designs—but once the shift is in place the annual costs will not necessarily be any more than current expenditures on textbooks and curricular materials.

- Textbooks must be rewritten (or even reconceived as laptop-based software packages), to present knowledge in the developmentally appropriate sequence suggested by the learning sciences, and to present knowledge as a coherent, integrated whole, rather than as a disconnected series of decontextualized facts.

- The shift to customized, just-in-time learning will result in a radical restructuring of the school day, and will make many features of today’s schools obsolete: schools years will no longer be grouped by age, school days will no longer be organized into class periods, standardized tests will no longer be administered en masse to an auditorium of students, not everyone will graduate high school or start college at the same age. Many of the socially entrenched aspects of schools that are not directly
related to education will have to change: organized sports, extracurricular activities, class parties used as rites of passage.

The relationship between the institution of school and the rest of society may need to change, as network technologies allow learners to interact with adult professionals outside the school walls, and as classroom activities become increasingly authentic and embedded in real-world practice.

Standardized tests must be rewritten to assess deep knowledge instead of surface knowledge, and to take into account the fact that due to customization, different learners might learn different subject matter.

Teacher education programs must change to prepare teachers for the schools of the future rather than the instructionist schools of the past.

We are at an exciting time in the learning sciences. The work began in the 1970s, in psychology, cognitive sciences, sociology, and other disciplinary traditions. In the 1980s and 1990s, researchers increasingly worked closely with educators and in schools. As these scholars continue to work together in a spirit of interdisciplinary collaboration, the end result will be an increasingly detailed understanding of how people learn. And once that understanding is available, the final step to transform schools must be taken by our whole society: parents and teachers, and the administrators and politicians who we entrust with our schools.

**Significance**

The proposed session will be significant because the release of this first handbook represents an important coming of age event for the learning sciences community. It is the first time that the core findings emerging from the learning sciences have been collected into a single volume. As such, it provides an opportunity for the field to reflect both inwardly and outwardly—both on the next steps for the learning sciences, and on how this research could impact education in the future. The interactive session format will provide a unique opportunity for the panelists to present their views on these issues. It will also provide an opportunity for handbook contributors and other members of the community to participate in an open discussion about the role of the learning sciences, and to work together to determine the best new directions for future research.

**References**

