EDITORIAL

Inaugural issue perspectives on *Information and Learning Sciences* as an integral scholarly nexus

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Abstract

Purpose – Many of today's information and technology systems and environments facilitate inquiry, learning, consciousness-raising and knowledge-building. Such platforms include e-learning systems which have learning, education and/or training as explicit goals or objectives. They also include search engines, social media platforms, video-sharing platforms, and knowledge sharing environments deployed for work, leisure, inquiry, and personal and professional productivity. The new journal, *Information and Learning Sciences*, aims to advance our understanding of human inquiry, learning and knowledge-building across such information, e-learning, and socio-technical system contexts.

Design/methodology/approach – This article introduces the journal at its launch under new editorship in January, 2019. The article, authored by the journal co-editors and all associate editors, explores the lineage of scholarly undertakings that have contributed to the journal's new scope and mission, which includes past

and ongoing scholarship in the following arenas: Digital Youth, Constructionism, Mutually Constitutive Ties in Information and Learning Sciences, and Searching-as-Learning.

Findings – The article offers examples of ways in which the two fields stand to enrich each other towards a greater holistic advancement of scholarship. The article also summarizes the inaugural special issue contents from the following contributors: Caroline Haythornthwaite; Krista Glazewski and Cindy Hmelo-Silver; Stephanie Teasley; Gary Marchionini; Caroline R. Pitt; Adam Bell, Rose Strickman and Katie Davis; Denise Agosto; Nicole Cooke; and Victor Lee.

Originality/value – The article, this special issue, and the journal in full, are among the first formal and ongoing publication outlets to deliberately draw together and facilitate cross-disciplinary scholarship at this integral nexus. We enthusiastically and warmly invite continued engagement along these lines in the journal's pages, and also welcome related, and wholly contrary points of view, and points of departure that may build upon or debate some of the themes we raise in the introduction and special issue contents.

Keywords Information literacy, e-learning, Learning analytics, Digital literacy, Library leadership, Constructionism, Maker spaces, Digital youth, *Information and Learning Sciences*, Inaugural issue, Searching as learning, Culturally responsive computing

Paper type Editorial

Introduction

Many of today's information and technology systems and environments facilitate inquiry, learning, consciousness-raising and knowledge building. Such platforms include e-learning systems which have learning, education and/or training as explicit goals or objectives. They also include search engines, social media platforms, video-sharing platforms and knowledge sharing environments deployed for work, leisure, inquiry and personal and professional productivity. Learning may be an outright target goal of designers and/or users in such environments, or it may be an implicit by-product of naturalistic technology design and engagement in such contexts, occurring socio-cognitively behind the scenes in both developers' goals and objectives, and in participants' experiences. These socio-technical system convergences in information and communications technologies (ICTs) and information systems, as they relate to learning phenomena, are also occurring in parallel within the scholarly literature.

Information science (IS) and the learning sciences (LS) are two disciplines in which these convergences are being increasingly recognized. Information science is a field of scholarly inquiry whose boundaries and dynamics are constantly evolving, and the field has been described as the science and practice of effective collection, storage, retrieval, and use of information, concerned with recordable information and knowledge and the technologies and related services that facilitate their management and use (Saracevic, 2009). Scholarship in this inter-disciplinary field integrates perspectives from the social and behavioral sciences, computer science, socio-technical systems research, archival and library science, cognitive science, digital humanities, linguistics, museology, management, public policy and more.

Learning Sciences is another inter-disciplinary scholarly domain that has been defined as the study of teaching and learning in both formal and informal settings, and which draws on knowledge from fields including cognitive science, sociocultural theory and social constructivism, educational psychology, computer science, information sciences, and design studies among others (Sawyer, 2014). Approaches privilege design in methodology and pedagogy, emphasizing interdisciplinarity and methodological innovation in research that is grounded in real-world contexts (*Journal of the Learning Sciences* mission, 2018). This work answers questions about learning processes and mechanisms, alongside outcomes. Research in this domain pursues technological and pedagogical innovation, maintaining a strong connection between research and practice (2018). A broad range of contexts are represented in this research; any context in which learning is occurring, is open terrain. The fundamental

focus is on understanding the processes, tools, and contexts, as well as outcomes, of learning in its myriad forms (2018).

Theoretical, methodological and empirical convergences in IS and LS have been recognized in the context of several generative international workshops, conference panels and seminars, special issues of several journals, and special interest groups within national associations covering topics at these inter-disciplinary boundaries. In such venues, scholars who identify with both fields have met, engaged in discourse, identified new collaborative research projects, design and development initiatives, technological and pedagogical innovations, and community programs. The following list of scholarly venues where these works have been presented, is just a selection. Such work has been conducted by researchers from both disciplines, whose scholarly homes and affiliations often cross these two fields as we navigate our professional journeys.

Conference workshops and seminars

- 2014 Digital Youth Seattle Think Tank, University of Washington School of Information Studies (Fisher *et al.*, 2016);
- 2014 iConference Workshop "Connecting Fields, Connecting Scholars: Breaking Down the Walls between Learning and Information Sciences" (Ahn *et al.*, 2014);
- 2014 Information Interaction in Context (IIiX) workshop on "Searching as Learning" (Freund *et al.*, 2014);
- 2015 iConference "Digital Youth" workshop (Juncker *et al.*, 2015);
- 2016 SIGIR Search as Learning Workshop (Gwizdka *et al.*, 2016);
- 2017 Schloss Dagstuhl seminar on "Search as Learning" (Collins-Thompson *et al.*, 2017);
- 2017 ASIS&T SIG InfoLearn Pre-Conference Workshop: *Information and Learning Sciences* as an Integral Scholarly Nexus (Reynolds and Rieh, 2017); and
- 2018 ASIS&T SIG InfoLearn Pre-Conference Workshop: Coordinating Scholarship in Searching as Learning (Reynolds *et al.*, 2018).

Journal special issues

- 2016 *The Information Society* special issue, "Revealing Mutually Constitutive Ties between the *Information and Learning Sciences*" (Guest Editors: Ahn and Erickson, 2016);
- 2016 *Journal of Information Science* special issue, "Searching as Learning," (Guest Editors: Hansen and Rieh, 2016); and
- 2017 *Information Retrieval Journal* special issue, "Searching as Learning" (Guest Editors: Eickhoff *et al.*, 2017).

The new journal, *Information and Learning Sciences*, sets out to support the ongoing productive development of the scholarship that is converging in these fields. The journal title has transitioned from a previous one, *New Library World*, after discussions beginning in 2016 among Professors Sam Chu, Rebecca Reynolds, and the publisher, Emerald UK, about the opportunity to develop an updated venue representing a new and exciting focus, scope and mission, given Chu and Reynolds' research experiences in interdisciplinary scholarship in both domains (e.g., Chu *et al.*, 2016). The charter of the earlier title and its transition is described in Baker (2018). The journal is officially launching in this current inaugural edition as *Information and Learning Sciences*, under a new editorship and an associate

editor team that includes Professors June Ahn, Simon Buckingham Shum, Preben Hansen, Caroline Haythornthwaite, Hong Huang, Eric Meyers and Soo Young Rieh.

The journal aims to advance our understanding of human inquiry, learning and knowledge building in human design and uses of information systems, e-learning systems and socio-technical system contexts that may or may not have been designed with learning as an intended purpose, process and/or outcome. Under the new editorial team, advisory board, and reviewer community, we aim to provide a rigorous scholarly space to explore phenomena at the intersections of these two fields of inquiry. The editorial advisory board brings together over 70 leading international scholars who are evenly divided between and across these two disciplines. We intend to maintain this balance of equivalency in leadership. Toward these efforts, we have a number of special issues slated for the next two years co-edited by new and established leaders in both domains, listed on the journal website.

To chart the course for the journal's scope and mission and set a standard for quality, the editorial team decided to launch with an inaugural issue of eight articles that are comprised mainly of theoretical syntheses and editorial essays, alongside three works that report empirical study research findings as exemplars. Authors were chosen by the editorial team based on their known thought leadership at this intersection, and the articles underwent a single-blind review process with a period of revisions. All articles and issues moving forward will be double-blind peer reviewed to reflect both fields' standards of editorial excellence. We invite all interested experts and emerging scholars in our two disciplines, to submit work and volunteer as reviewers in these pursuits.

We enthusiastically and warmly invite continued engagement along these lines in the journal's pages, and also welcome related, and wholly contrary points of view, and points of departure that may build upon or debate some of the themes we raise in this introduction and inaugural issue. Indeed, this ship has only just left port and we are so looking forward to sharing its command collaboratively – with our entire community of cross-disciplinary scholars and scholars-in-preparation, offering a venue to directly and creatively engage in these intersections with a greater level of consciousness, deliberation and recognition of this inter-disciplinarity.

In the remainder of this editorial, we present a brief summary narrative discussing four recent areas of interdisciplinary research from which the journal has emerged, before summarizing each of the articles.

Four strands of existing inter-disciplinary scholarship at this intersection

Here we discuss four domains of scholarship that have contributed to this journal's establishment: scholarship in the fields we might summarize as *Digital Youth, Constructionism, Mutually Constitutive Ties in Information and Learning Sciences* and *Searching as Learning.* The scholarly productivity in these areas provides evidence of the promise, timeliness and need for continuing support for such work, but as later explained, topics of interest to IS and LS are by no means restricted to these.

Digital Youth. Digital Youth research as a domain and category of scholarship in information science tracks results emerging from the study of young people's engagement with information and communication technologies (ICTs), learning innovations and information systems. The "Digital Youth" Think Tank in 2014 hosted by the University of Washington iSchool, and the iConference Workshop in 2014 by that same name provides anchors for this work. A selection of organizers from these events published a white paper (Fisher, Davis, Yip, Dahya, Mills, Eisenberg, 2016) that documented the Think Tank's rationale and outcomes. A highlight of the white paper includes the summary provided of the main points of Eisenberg's keynote which drew upon Dr Eliza Dresang's (1999) Radical Change theory to explain ways in

which today's youth both drive and are affected by, technological change. Also described in the white paper are the event's six areas of focus: Digital and Information Literacies, Formal and Informal Learning, Games and Learning, Mind, Brain and Behavior, Social and Mobile Media, and Information and Digital Policy. Overall, the Digital Youth initiative provided a host of promising directions for continued research development that the journal seeks to support.

Constructionism. Social constructivism and sociocultural theory (Vygotsky, 1978; Gee, 2007), Constructionism (Harel, 1989; Harel and Papert, 1990, 1991; Kafai and Resnick, 1996), and situated cognition (Brown, Collins, and Duguid, 1989) are theories and approaches to understanding learning that have influenced a large number of scholars in the learning sciences. We briefly highlight the Constructionist lineage of research and development out of MIT Media Lab. As a "framework for action" in computing education (diSessa and Cobb, 2004), it has been highly influential in the design and development of innovative educational interventions and e-learning technologies that have been deployed by researchers to explore a wide range of research questions in diverse contexts, in which human learning with technology has been a goal.

Constructionism builds upon Vygotsky's (1978) social constructivist and Piaget's (1959) constructivist theories, and in this approach, students engage in conscious construction of a computational artifact in a workshop-style group educational environment led by expert guides and mentors who support the learner, alongside peers who also contribute. In workshop-based educational settings, participants engage in extensive dialogue and discourse with mentors and peers, while afforded ample concentrated time on task for their project-based and computational learning (Harel and Papert, 1991; Kafai and Resnick, 1996; Reynolds, 2016). Constructionism centers on students' creativity, inventiveness, and learning about learning (Blikstein, 2013), holding that individuals learn best when participating in personally meaningful computational learning pursuits in which their work is valued as part of a larger social enterprise, for example creating a computational game artifact that is playable by other young learners, eliciting meta-cognitive gains in both the designer and the player/user (Barron and Darling-Hammond 2008, Stager, 2001). The third volume on Constructionism (Holbert, Berland and Kafai, 2019, forthcoming) will be entitled, "Constructionism in Context" and published in 2019 by MIT Press.

Research in Constructionism and the other sociocultural learning arenas have influenced the design and study of learning systems in the games, learning and society (GLS) community of researchers (Gee, 2007; Steinkuehler, 2006; Squire, 2007) as well as influencing research on game design for learning (Kafai and Burke, 2015), and e-crafting and e-textile learning research (Buechley *et al.*, 2013; Kafai *et al.*, 2014). Such theoretical domains have inspired a large corpus of the research on "making" activity, occurring in contexts such as maker spaces in settings including schools, libraries, and community centers. All of these areas are most welcomed and invited for publication in the journal.

Mutually constitutive ties between information and learning sciences. In 2014, Ahn, Erickson and Meyers organized an iConference workshop entitled "Connecting fields, connecting scholars: Breaking down the walls between Learning and Information Sciences." In that workshop, scholars in IS and LS identified research agendas and perspectives that were naturally synergistic to better understand how theoretical approaches across fields could mutually inform one another. One outcome of this workshop was a 2016 special issue of *The Information Society* (TIS) coedited by Ahn and Erickson. The papers featured focused on documenting current experiences of learning with ICTs that blended approaches across fields. For example, the issue highlighted how new infrastructures continually shape how learning is experienced, from OLPC laptop programs that entire nations implement

(Ames, 2016) to online platforms that recognize out of school learning (Davis and Fullerton, 2016). New technologies intersect with theories of assessment, enabling new ways to recognize learning (Casilli and Hickey, 2016), or how massive collectives can crowdsource learning together through online communities (Paulin and Haythornthwaite, 2016). Finally, any intersection of technology, information and learning will always rest on fundamental social concerns such as recent advances in learning analytics shedding the spotlight on enduring concerns of ethics and privacy (Rubel and Jones, 2016).

These themes continue to define the boundaries of scholarship that intersect IS and LS. For example, a recent, edited book by Lee and Phillips called *Reconceptualizing Libraries: Perspectives from the Information and Learning Sciences* (2018), takes as its starting point an example of infrastructure that is a prominent target of study for information scientists – libraries – and considers how learning is enabled, guided and experienced in these infrastructures, integrating LS perspectives in some new directions for library studies. Overall, the TIS special issue and the workshop upon which it was developed set an integral foundation for the present-day forays of the editors, associate editors, and editorial advisory board, in setting forth establishment of this journal.

Searching as learning. Search systems such as Web search engines or database retrieval systems, have traditionally focused on accuracy and efficiency: delivering a set of highly relevant search results quickly to individual users with well-defined information tasks. More recently, there has been a growing acknowledgement of the importance and necessity of studying and designing search systems to foster exploration and discovery, that the learning experience *during* the search process is just as important as the learning that occurs with retrieved documents. Searching as Learning (SAL) research has been largely pursued by information retrieval-focused scholars who have set out to re-frame research on information-seeking and retrieval in terms of human learning processes.

In the 2016 special issue on this topic in the *Journal of Information Science*, Rieh *et al.* (2016) offer a perspective that focuses on the learning that occurs during the search process, as well as search outputs and learning outcomes. They propose a concept they term 'comprehensive search,' to describe iterative, reflective and integrative search sessions that facilitate critical and creative learning beyond receptive learning. They propose that system enhancements may lead to richer representations of information, learning and domain expertise, embedding learning motivation, intentions, knowledge levels, content diversity, and more (2016). They also discuss how search interaction data can provide a rich source of implicit and explicit features through which to assess search-related learning. Overall, they propose that extensions that situate search in these ways may contribute to reconfiguration of search systems from information-retrieval tools to rich learning spaces in which search experiences and learning experiences are synergized. They propose four promising domains for future work:

(1) *System*: Developing a search system that supports sense-making and enhances learning.

(2) *Interaction*: Supporting effective user interaction for searching as learning.

(3) *Information literacy*: Providing inquiry-based information literacy tool within a search system.

(4) *Learning assessment and comprehensive search*: Assessing learning from online search behavior.

Another special issue on this topic appeared in *Information Retrieval Journal* in 2017, focusing on demonstrating research efforts in modeling learning intent and learning activities in the context of information retrieval. The editors point out that in the field of information retrieval, document relevance has been judged in isolation in search engine results, rarely incorporating

the notion of "contextual learning." As a result, current search engines are not optimized for offering learning space in which users can interact with diverse set of search results (Eickhoff *et al.*, 2017). The articles in this special issue investigated various topics including search strategies for knowledge acquisition, a framework for collaborative learning and searching, retrieval techniques for enhancing learning efficiency, and supporting youth learning by providing documents that match their reading abilities. In addition, a Schloss Dagstuhl Seminar on Search as Learning in Wadern, Germany brought together 26 researchers from diverse disciplinary areas such as information retrieval, information behavior, learning sciences, neuroscience, and psychology to discuss similar themes.

Overall, the SAL research domain represents a highly interdisciplinary field in which researchers with diverse backgrounds may collaborate to generate new perspectives to redesign search systems to foster and enhance the learning experience during search. The future endeavor of changing a research paradigm from fast and efficient cross-sectional interactions of information retrieval to more extended search processes supporting learning over time, presents challenges in conceptual cross-sections that the journal aims to support. A recommendation for those working in this space to move "Beyond Bloom's Taxonomy" in conceptualizations of learning processes has been noted by Reynolds and Hansen (2018) and Reynolds *et al.* (2018). Cross-disciplinary research efforts will help advance this goal, offering potential for significant impact in realizing newer forms of intelligent search systems designed from conception to support human learning.

E-learning perspectives as a bridge

The challenges and opportunities of charting these inter-disciplinary boundaries and advancing conceptualizations of learning have been addressed in other works of synthesis situated in information science to-date. For instance, Haythornthwaite and Andrews (2011) discuss this in their valuable research syntheses of the arena of "e-learning" research, which they define broadly as a transformative movement in learning, not just the transfer of learning to an online stage. In discussing the broad contexts involving learning phenomena within ICTs and information systems, the authors embrace the ways in which learning flows across physical, geographical, and disciplinary borders. They describe e-learning as perpetual, sustained over a lifetime, and enacted in multiple daily occurrences as we search for information to satisfy our learning needs and contribute content ourselves that promotes our and others' understanding (2011). They state that in e-learning, teachers and learners use technology to create the social space in which learning occurs, which includes psychological space that is sustained in learning across multiple devices and activities; cyberspace; and physical space, for instance using technology to connect learning to locations or objects in cities and museums (2011, p. 2). Some scholars who publish in these domains draw upon the design-based research (DBR) method in developing new e-learning innovations (Hoadley, 2004; Barab and Squire, 2004; Cobb *et al.*, 2003; Wang and Hannafin, 2005).

The broad definition these scholars offer recognizes that e-learning affordances are expanding, and their aim is to allow "e-learning" as a category to be inclusive of the existing and future range of innovations. In an updated volume, Haythornthwaite *et al.* (2016) highlight newer e-learning developments that have garnered recent attention. These include: video-based resources for teaching and learning; games and gamification of learning; massive open online courses (MOOCs); enhanced means of helping learners navigate their way through materials, such as lecture recordings that can be annotated; adaptive learning systems that determine next steps according to learner progress and types of error; dashboards that show progress or effort in comparison to other learners; embedded tutors (2016). All of these socio-technical systems research contexts offer promise for ongoing productivity.

Haythornthwaite *et al.* (2016) summarize the arenas where one may find extended accounts of high-quality evidence-based learning innovation as follows: learning sciences, computer-supported collaborative learning, networked learning, educational data mining, learning@scale and learning analytics. The state of the art can be found in the International Conferences and journals such as *Learning Sciences* and *Computer-Supported Collaborative Learning and Learning Analytics*. A recent synthesis of how these fields are converging in productive dialogue was presented by Buckingham Shum (2018), drawing on infrastructure studies, another influential "sister" community (Bowker and Star, 1999; Edwards *et al.*, 2013).

Conclusion

In this introduction, we have summarized a selection of key developments in four scholarly domains that provide justification and rationale for the new journal launch. ICTs, e-learning innovations and information system platforms continue to develop and evolve in the onward march of progress. We hope and expect that learning phenomena will be increasingly identified as important to their study. In this regard, recently, a United Nations report based on 62 expert policy briefs was drafted by 245 scientists and technologists from 27 countries as a result of the Rio + 20 Conference on sustainable development (United Nations, 2016). The report's chapter 3 proposes that ongoing development of ICT platforms may contribute towards greater "science, technology and innovation literacy" (STI literacy) in the populace and among scientists. The report highlights ways in which STI literacy and development of more sustainable infrastructures may contribute to solutions innovations addressing the main UN-identified "global issues" worldwide, which include climate change, socio-economic, race and gender inequality, etc. (2016). Modestly, we hope that the works published in this journal may contribute in some small way towards the advancement of such solutions, to the extent that ICT, e-learning and information system innovations require and facilitate human learning across the lifespan.

At the same time, when considering learning affordances of ICTs and information systems, we must also recognize that technology developments, and expectations over their uses also *contribute to* equity gaps, and technology hardware manufacture and their uses also have impacts on the environment, hence the sustainability focus in the UN report. Indeed, the report cautions, "Technology change itself is often not neutral. Instead, it is often biased toward capital and skilled labour and hence has significant distributional effects leading to increased inequality" (p. 42). Therefore, we advocate research approaches demonstrating culturally responsive computing principles supporting e-learning technologies' adaptivity to the needs of varying learner communities (Ladson-Billings, 1995; Vavrus, 2008; McLoughlin, 1999; Henderson, 1996, 2007; Pinkard, 2001; Lee, 2003; Eisenhart and Edwards, 2004; Goode and Margolis, 2011; Margolis *et al.*, 2012; Eglash *et al.*, 2013; Scott *et al.*, 2015). Such approaches hold equity and social justice as central in computing education research, bringing community contextual concerns directly into the teaching and learning design framework and experiences of participants, holding promise in achieving a more equitable and sustainable socio-technical balance.

Human-centered perspectives. Human-centered perspectives on e-learning design are often a hallmark of learning sciences research which focus on *improving upon* learning experiences rather than simply replacing older modalities with new ones (Scott *et al.*, 2014; Reynolds and Harel, 2019, forthcoming). At the K-12 level especially, where public education is a mandate, providing evidence-based improvements in computing education becomes an equity issue because new affordances must equal or improve upon accessibility, learning processes and outcomes for public school children over and above the modalities they replace (Collins and Halverson, 2009; Collins, 2017). In this regard, learning sciences scholarship offers key advances in the scientific understanding of scaffolding, and

personalizing appropriate levels of structure for diverse learner needs – as individuals and in groups, in context and *in situ* (Kirschner *et al.*, 2006; Hmelo-Silver *et al.*, 2007; Sweller *et al.*, 2007). Individuals and groups differ in their need for structure; instructional design affordances must account for this (e.g., Worsley and Blikstein, 2013).

For researchers who may be new to integrating learning sciences perspectives, and who wish to explore evidence-based conceptualizations of learning, we recommend as a starting point, a small selection of meta-synthesis works including the National Academies Press (NAP) publications, *How people learn* (Bransford *et al.*, 1999) and *How people learn II: Learners cultures and contexts* (National Academies of Sciences, Engineering, and Medicine, 2018), both freely available on the NAP website. The 1999 report summarizes insights on the nature of learning in school-aged children, describes principles for the design of effective learning environments, and provides examples of how such principles can be implemented in the classroom. The later work (2018) expands upon the evidence base, adding categorical findings of scientific understanding of the mechanisms of learning and the role of technologies, and scholarly syntheses on how the brain adapts throughout the lifespan, taking into account a range of influences on learning, particularly the constellation of sociocultural factors and the structure of learning environments. We also recommend perspectives on collaborative lifelong learning among adults in work contexts discussed in depth in Goggins *et al.* (2013), resulting from workshops at the ACM International Conference on Supporting Group Work (GROUP) and the Computer-Supported Cooperative Work and Social Computing (CSCW) conference, which contributed to this full-length book publication. We recommend a series of meta-syntheses and meta-analyses conducted by leading scholars in the CSCL research domain (Jeong and Hmelo-Silver, 2016; Jeong *et al.*, 2014; Jeong *et al.*, 2016; Jeong and Hmelo-Silver, 2015) as further starting points.

Journal scope and mission

In closing, as of January 2019, the journal's scope and mission are stated as follows on the Emerald website. We expect this statement will be continually revised and we welcome suggestions for additions, revisions and adaptations as the technological, theoretical, methodological, and empirical terrain and contexts continue to evolve.

Website copy: "The journal invites research that builds upon and advances theories, methods, results, innovation designs, evidence bases and frameworks for action present across both information science, and the learning/education sciences scholarly domains. We especially welcome the submission of papers that directly address, explicate and discuss the inter-disciplinary boundaries and intersections present across these two fields, and that offer new conceptual, empirical and technological syntheses. Such investigations may include but are not limited to:

- e-learning perspectives on searching, information-seeking, and information uses and practices engaged by a full diversity of youth, adults, elders and specialized populations, in varied contexts including leisure time activities; e-learning at work, in libraries, at school, home, during playtime, in health/wellness settings, etc.;
- design and use of systems such as MOOCs, social media, learning management systems, search systems, information systems, and other technology design innovations that contribute to human inquiry, formal and informal learning, searching, information-seeking, information uses, knowledge building and sharing, and instruction;
- HCI, socio-technical systems research, and materiality research perspectives on information and learning systems design; social learning ecologies; and creation and use of physical objects and settings that elicit human inquiry and learning;

- culturally responsive computing;
- ethnographic; emancipatory; social justice-based; feminist; critical race theory; and post-structuralist research involving information, learning, equity, design;
- information, communication, and technology (ICT) considerations in computer supported collaborative learning (CSCL) contexts;
- innovations and e-learning solutions that address digital/information/media/data literacy and/or address the digital divide;
- innovations involving problem-, project-, and inquiry-based learning contexts and goods;
- learning analytics and/or data science perspectives on measurement and analysis of learning in information/search/e-learning systems;
- critically informed perspectives on the role of algorithms in information and learning systems; and
- social and ethical issues in e-learning contexts such as design, measurement, and evaluation – including privacy and security concerns around student confidentiality, data ownership and ethical data uses by researchers, teachers, institutions."

We place the ongoing emergence of these works in the hands of our readers and contributors, to continue weaving the narrative threads we have only begun to identify and unfurl in the terrain mapped and summarized herein. We most warmly invite your contributions in the journal: *Information and Learning Sciences*. To launch this new endeavor, we are most excited to share the generous work of our inaugural issue collaborators, described in brief as follows, to advance all of our work in continuing new directions.

Summary of contributions in this special inaugural issue
Learning, Connectivity and Networks. In the first article, "Learning, Connectivity and Networks," Caroline Haythornthwaite demonstrates how "the network" has served as a lens onto learning contexts from informal online information exchanges, to formal educational platforms, to MOOCs, but also offline communities of practice. Established theories and academic communities reflect the centrality of network analysis, including *networked learning, social learning and ubiquitous learning*. "Learning" and "networks" come together in a range of configurations, both process and product, as learning has been framed variously "as a social network relation, a relationship, a network outcome of relations in the form of learning and knowledge communities, and an outcome of ambient awareness and influence." In summary, Haythornthwaite provides a compelling exampling of how the information and learning sciences share common ground in their use of social network analysis, but with different emphases and purposes.

Scaffolding and Supporting Use of Information for Ambitious Learning Practices. Krista Glazewski and Cindy Hmelo-Silver provide a synthesis of a robust area of research in the learning sciences around ambitious learning practices (ALP) and problem-based learning (PBL); where teachers in formal classrooms try to recreate these powerful learning environments for students. They highlight how our careful structuring and use of information are critical components of ALP and PBL approaches. For example, learners need careful scaffolding and guidance in searching for, understanding, and arguing from evidence as they progress in solving problems together, and developing a shared understanding of phenomena in the world. Understanding how information seeking intersects with ambitious learning experiences represents a clear opportunity for the nexus of information and learning sciences. The most transformative learning experiences occur

when learners are faced with interesting, personally relevant, challenging, and timely problems to solve. Such situations also require careful guidance and support, if learners are to gain the maximum benefit from pursuing these problem-based inquiry opportunities. Thus, the implications of this research stream are substantial as we seek to better support learners across a wide range of informational, and educational, environments.

Learning Analytics: where information and learning sciences meet: in this paper, Stephanie Teasley introduces learning analytics (LA) as a field in which information scientists and learning scientists could recognize their common ground. The paper notes that interdisciplinary effort is crucial to advance learning analytics-based interventions in education. The paper discusses what LA would "do" for researchers, explaining how blending two kinds of data – student data and behavioral data – makes it possible to represent both "process of learning" and "products of learning." Teasley also emphasizes the importance of utilizing the results of LA research to make an impact on effective educational practice, such as designing personalized learning trajectories. The highlights of this paper are a set of commonalities she has identified across three research communities: learning science, learning analytics, and iSchools:

(1) shared values that information is inherently a public good;

(2) a learner-centered approach that is collaborative and iterative in both formal and informal learning environments; and

(3) ethics and privacy-related issues in using profiling and sharing educational data.

Teasley takes dashboard research as an exemplary area in which the collaboration of information scientists and learning scientists can make a difference in analyzing the data generated from dashboards. Without learning science theories, dashboard evaluation research would not be able to demonstrate student learning outcomes and experiences directly, and as a result, it would be extremely difficult to make sense of student data. Teasley concludes her paper by emphasizing the importance of taking theory, methodology, and technology innovation needs to be "rearranged and reassembled" from multidisciplinary perspectives to provide new insights for learning analytics research.

Search, sense making and learning: closing gaps. In this article by Gary Marchionini, a major claim is that electronic information tools and environments have increased the number and the intensity of overlaps between search and learning. Furthermore, sense making processes are a growing importance as a salient and bridging process between search and learning. A sense making process that involve activities such as understanding, interpreting, and reflecting on information units. Search for information serves as a sub-task of learning, and thus, learning is situated in information seeking and information as overlapping activities. As sense making processes are important especially during result examination, sense making serves as a component of search and may serve as a bridge between search and learning. Humans are learning systems and dimensions such as neural, cognitive, affective and behavioral, are pointed out as important in a holistic way to close the gap across dimensions and to understand the emergent conditions of learning. Marchionini presents a model in which sense making is depicted as the intermediary between search and learning where a mental model for the object of learning is contextualized. On one side retrieval and information seeking is place and on the other side intentional and incidental learning are placed and thus, sense making is increasingly an important sub-task for learning especially when dealing with bridging the gap of our understanding of searching and learning. Finally, search and learning both change people in ways that sometimes are predictable and in some other cases are unintended. These changes are typically influenced by issues such as emerging information technologies, access to data and information services.

Overall, in this paper, search is positioned as a sub-task to learning and with this Marchionini means that people do learn to search while involved in the search process and the major process that might 'close the gap' between searching and learning would be to consider sense making as the intermediary between these two processes. Marchionini stresses that complex search activities requires cognitive demands in various ways and that one of the demands are how to make sense of possible relevant search streams that people are engaging in everyday information access. In that quest, we need to build bridges to neuroscience and behavioral science research communities.

Supporting learners' STEM-oriented career pathways with digital badges. Caroline R. Pitt, Adam Bell, Rose Strickman and Katie Davis discuss digital badges as a new kind of assessment and credentialing system for recognizing and rewarding learning across formal and informal learning environments. Despite considerable enthusiasm and speculation about the use of digital badges, the extent to which they can empower learners and link their learning in STEM workforce and schools remains largely uninvestigated. This paper aims to fill the gaps in understanding the potential of digital badges that can support alternative learning and career development pathways. The study used a thematic analysis of in-depth interviews with stakeholders (n = 30) in higher education and industry. Stakeholders (e.g. employers and college admission officers) discussed how digital badges can change the current process of recruiting undergraduate students and hiring young professionals. Interview participants expressed optimism about the potential of digital badges that allow learners and external audiences to see learning pathways and promote fairness in STEM education and careers. Participants pointed out some badge challenges, mainly focusing on the credibility, integration as a process and product, and triviality of badges. This article directly addresses the practical application of digital badges by discussing practical issues with university admissions officers and employers. Educational policy makers, employers and academics will be able to use the insights of this study to find innovative ways to establish valid and reliable assessments, and to support selection processes. Educators and employers can use digital badges to effectively implement, expand, and diversify the STEM workforce, and support a wider range of learners, rather than the current school-workforce pipeline.

Thoughts about the past, present and future of research on youth information behaviors and practices. Denise Agosto provides an overview of twenty years of research with youth, predominantly from an information science perspective, where such work is often framed as "information behavior." This term can be confusing to those who are new to the field: how does information "behave"? Is such work predicated on a behaviorist approach to learning? Agosto explains, drawing on seminal work of Tom Wilson (2000) that information behavior encompasses the wide range of activities that people engage in that involve information and communication technologies, including active work and play such as research in school or texting friends, as well as "passive" consumption of media. Learning is an essential part of using information to make decision, engage in civic discourse, and make sense of the world. It is also inherently social, and recent work in the field has emphasized the shared and collaborative aspects of information seeking and use with young people. Studying how children use social networks, digital libraries, app-based literacy tools, to name just a few, are important points of intersection for scholars in information and learning sciences, although little of this work seems to cross disciplinary boundaries. Agosto calls for more work and an expanded set of inquiry questions, both in terms of who seeks information (in terms of demographic factors) and the what/how of that process (what tools and techniques are used).

Agosto's work reminds us that youth describe and understand their behaviors with information resources and technologies in different terms than adults do. Often a gap exists

between what youth and adults do and value with technology, and Agosto's article warns of approaching research from a deficit model (i.e. pointing out where young people fall short of expert performance rather than emphasizing what youth do well). She stresses the importance of a youth-oriented research perspective that values young people as experts in their own behaviors, a perspective shared across a range of scholarship in digital and critical literacies, internet research, and communication studies.

Leading with love and hospitality

Applying a radical pedagogy to LIS. Nicole Cooke's article addresses an important issue of how to use different strategies to improve librarianship education, management and delivery of culturally responsive pedagogy in LIS. The article is engaged with many real life examples of librarianship practices and LIS education nuances, and how they could make changes to the current status of pedagogy. There is also detailed background knowledge regarding approaches towards radical hospitality, radical love, radical honesty, and radical candor in LIS education, with explanation of how they all link to different pedagogies. These include *feminist pedagogy, engaged pedagogy, and sentipensante pedagogy*. Humanizing pedagogy is an important aspect that is thoroughly elaborated in the paper. The discussion in this paper has important implications in how to improve relationships among LIS educators, librarians, and learners, and how educators may model the classroom strategies in educating library leaders, in their own professional practice based on the suggestions. The approaches presented represent a radical departure from many LIS education norms and values, and offers an innovation in teaching and learning to support greater equity and inclusion in the field.

On researching activity tracking to support learning

A retrospective. In his article, "On researching activity tracking to support learning: A retrospective," Victor Lee provides an overview of research into the use of personal fitness tracking tools such as fitness bands and mobile phone apps, and the analytic reports they generate. He compares and contrasts an information sciences approach to studying their everyday usage (by adult endurance athletes), with a learning sciences approach which designs specific uses of the tools by school children during recess, with the objective of improving their understanding of statistics. The study of the naturalistic, longitudinal use of the tools provides valuable insights into what is learned from such analytics, the positive and negative effects that quantifying activity can have on the experience of that activity, and the practices that the adults developed to manage these. In addition, this mode of study provided insights that informed the design of the controlled trials with children, with formal educational outcomes, assessments and research evaluations. Once understood through careful field research, the same dynamic that motivates millions of adults to quantify their activity turns out to be a powerful means of engaging children with data and statistical concepts, when the intervention is designed well. As such, this paper provides the inaugural issue with an insightful example of how the information and learning sciences can complement each other methodologically, and in terms of the insights they can provide.

References

Ahn, J. and Erickson, I. (2016), "Introduction to the special issue revealing mutually constitutive ties between the information and learning sciences", *The Information Society*, Vol. 32 No. 2, pp. 81-84.

Ahn, J., Erickson, I. and Meyers, E. (2014), "Connecting fields, connecting scholars: breaking down walls between learning and information sciences", iConference Workshop 2014, Berlin.

Ames, M.G. (2016), "Learning consumption: media, literacy, and the legacy of one laptop per child", *The Information Society*, Vol. 32 No. 2, pp. 85-97.

Baker, D. (2018), (forthcoming), *'Editorial', Information and Learning Science*.

Barab, S.A. and Squire, K. (2004), "Design-based research: putting a stake in the ground", *Journal of the Learning Sciences*, Vol. 13 No. 1, pp. 1-14.

Barron, B. and Darling-Hammond, L. (2008), "Teaching for meaningful learning: a review of research on inquiry-based and cooperative learning", *Edutopia*, available at: www.edutopia.org/pdfs/edutopia-teaching-for-meaningful-learning.pdf

Blikstein, P. (2013), "'Digital fabrication and 'making' in education: the democratization of invention'", in Walter-Herrmann, J. and Büching, C. (Eds), *FabLabs: Of Machines, Makers and Inventors*, Transcript Publishers, Bielefeld.

Bowker, G.C. and Star, L.S. (1999), *Sorting Things out: Classification and Its Consequences*, MIT Press, Cambridge, MA.

Bransford, J.D., Brown, A.L. and Cocking, R.R. (Eds) (1999), *How People Learn: Brain, Mind, Experience, and School*, National Academy Press, Washington, DC.

Brown, A.L., Collins, A. and Duguid, P. (1989), "Situated cognition and the culture of learning", *Educational Researcher*, Vol. 18 No. 1, pp. 32-42.

Buckingham Shum, S. (2018), "Transitioning education's knowledge infrastructure: shaping design or shouting from the touchline? Keynote address", *Proceedings of the 13th International Conference of the Learning Sciences*, London, p. 5, available at: www.isls.org/icls/2018 (accessed 23-27 June 2018).

Buechley, L., Peppler, K., Eisenberg, M. and Kafai, Y.E. (Eds) (2013), *Textile Messages: Dispatches from the World of e-Textiles and Education*, Peter Lang Inc., New York, NY.

Casilli, C. and Hickey, D. (2016), "Transcending conventional credentialing and assessment paradigms with information-rich digital badges", *The Information Society*, Vol. 32 No. 2, pp. 117-129.

Chu, S., Reynolds, R., Notari, M., Taveres, N. and Lee, C. (2016), *21st Century Skills Development Through Inquiry Based Learning: From Theory to Practice*, Springer, Singapore.

Cobb, P., Confrey, J., diSessa, A., Lehrer, R. and Schauble, L. (2003), "Design experiments in educational research", *Educational Researcher*, Vol. 32 No. 1, pp. 9-13.

Collins, A. (2017), *What's Worth Teaching? Rethinking Curriculum in the Age of Technology*, Teachers College Press, New York, NY

Collins, A. and Halverson, R. (2009), *Rethinking Education in the Age of Technology: The Digital Revolution and the Schools*, Teachers College Press, New York, NY.

Collins-Thompson, K., Hansen, P., Hauff, C. and Klas, C.P. (2017), "Searching as learning", *Dagstuhl Seminar*, *17092*, March 2017, Wadern.

Davis, K. and Fullerton, S. (2016), "Connected learning in and after school: exploring technology's role in the learning experiences of diverse high school students", *The Information Society*, Vol. 32 No. 2, pp. 98-116.

diSessa, A. and Cobb, P. (2004), "Ontological innovation and the role of theory in design research", *Journal of the Learning Sciences*, Vol. 13 No. 1, pp. 77-105.

Dresang, E. (1999), *Radical Change: Books for Youth in a Digital Age*, H. W. Wilson Company, New York, NY.

Edwards, P., Jackson, P., Chalmers, M., Bowker, G., Borgman, C., Ribes, D., Burton, M. and Calvert, S. (2013), *Knowledge Infrastructures: Intellectual Frameworks and Research Challenges. Report from NSF/Sloan Foundation Workshop*, Ann Arbor, MI (May 2012).

Eglash, R., Gilbert, J.E., Taylor, V. and Geier, S.R. (2013), "Culturally responsive computing in urban, after school contexts: two approaches", *Urban Education*, Vol. 48 No. 5, pp. 629-656.

Eickhoff, C., Gwizdka, J., Hauff, C. and He, J. (2017), "Introduction to the special issue on search as learning", *Information Retrieval Journal*, Vol. 20 No. 5, pp. 399-402.

Eisenhart, M. and Edwards, L. (2004), "Red-eared sliders and neighborhood dogs: creating third spaces to support ethnic girls' interests in technological and scientific expertise", *Children Youth and Environments*, Vol. 14 No. 2, pp. 156-177.

Fisher, K., Davis, K., Yip, J., Dahya, N., Mills, J.E. and Eisenberg, M. (2016), *Digital Youth Think Tank White Paper*, University of Washington, DC, Seattle, WA.

Freund, L., He, J., Gwizdka, J., Kando, N., Hansen, P. and Rieh, S.Y. (2014), "Searching as learning (SAL) Workshop 2014", *Proceedings of the 5th Information Interaction in Context Symposium*, New York, NY.

Gee, J.P. (2007), *What Video Games Have to Teach us about Learning and Literacy*, Palgrave/Macmillan, New York, NY.

Goggins, S.P., Jahnke, I. and Wulf, V. (2013), *Computer-Supported Collaborative Learning at the Workplace*, Springer Nature, Switzerland, AG.

Goode, J. and Margolis, J. (2011), "Exploring computer science: a case study of school reform", *ACM Transactions on Computing Education (Education)*, Vol. 11 No. 2.

Gwizdka, J., Hansen, P., Hauff, C., He, J. and Kando, N. (2016), "Search as learning (SAL) workshop 2016", *Proceedings of the 39th International ACM SIGIR conference on Research and Development in Information Retrieval*, ACM, pp. 1249-1250.

Hansen, P. and Rieh, S.Y. (2016), "Editorial: recent advances on searching as learning: an introduction to the special issue", *Journal of Information Science*, Vol. 42 No. 1, pp. 3-6.

Harel, I. (1989), "The instructional software design project for learning mathematics in a computer-rich school", *Journal of Mathematical Behaviour*, Vol. 8, pp. 169-204.

Harel, I. and Papert, S., (1990), "Software design as a learning environment", *Interactive Learning Environments*, Vol. 1 No. 1, pp. 1-32.

Harel, I. and Papert, S. (1991), *Constructionism. Norwood*, Ablex Publishing, NJ.

Haythornthwaite, C. and Andrews, R. (2011), *E-learning Theory and Practice*, SAGE Publications Inc.

Haythornthwaite, C., Andrews, R., Fransman, J. and Meyers, E. (2016), *SAGE Handbook of E-Learning Research*, 2nd ed. Sage, London.

Henderson, L. (1996), "Instructional design of interactive multimedia: a cultural critique", *Educational Technology Research and Development*, Vol. 44 No. 4, pp. 85-104.

Henderson, L. (2007), "Theorizing a multiple cultures instructional design model for e-learning and e-teaching", in Edmundson, A. (Ed.), *Globalized e-learning cultural challenges*, Information Science Publishing, Hershey, PA, pp. 130-153.

Hmelo-Silver, C.E., Duncan, R.G. and Chinn, C.A. (2007), "Scaffolding and achievement in problem-based and inquiry learning: a response to Kirschner, Sweller, and, Clark", *Educational Psychologist*, Vol. 42 No. 2, pp. 99-107.

Hoadley, C. (2004), "Methodological alignment in design-based research", *Educational Psychologist*, Vol. 39 No. 4, pp. 203-212.

Holbert, N., Berland, M. and Kafai, Y. (Eds) (2019), "Constructionism in context: the art, theory, and practice of learning designs", MIT Press., Cambridge, MA.

Jeong, H. and Hmelo-Silver, C.E. (2015), "Research questions and research methods in CSCL Research", in Lindwall, O., Hakkinen, P., Koschmann, T., Tchounikine, P. and Ludvigsen, S. (Eds), *Exploring the Materials Conditions of Learning: Computer Supported Collaborative Learning (CSCL) Conference 2015*, International Society of the Learning Sciences. Gothenburg, Sweden, pp. 316-322.

Jeong, H. and Hmelo-Silver, C.E. (2016), "Seven affordances of CSCL technology: how can technology support collaborative learning", *Educational Psychologist*, Vol. 51 No. 2, pp. 247-265.

Jeong, H., Hmelo-Silver, C.E. and Yu, Y. (2014), "An eExamination of CSCL methodological practices and the influence of theoretical frameworks 2005–2009", *International Journal of Computer-Supported Collaborative Learning*, Vol. 9 No. 3, pp. 305-344.

Jeong, H., Hmelo-Silver, C.E., Jo, K. and Shin, M. (2016), "CSCL in STEM education: preliminary findings from a Meta-analysis", in *Proceedings of the 49th Annual HI International Conference on System Sciences*, IEEE Computer Society Press, *Piscataway, NJ*, pp. 11-20.

Journal of the Learning Sciences (2018), "Mission statement", available at: www.tandfonline.com/action/journalInformation?show=aimsScope&journalCode=hlns20

Juncker, B., Meyers, E., Martens, M., Balling, G., Fisher, K. and Todd, R. (2015), "Digital youth research network: defining the field, building connections, and exploring collaborations", *iConference 2015, Pre-conference workshop*, Newport, CA.

Kafai, Y.B. and Burke, Q. (2015), "Constructionist gaming: understanding the benefits of making games for learning", *Educational Psychologist*, Vol. 50 No. 4, pp. 313-334.

Kafai, Y.B. and Resnick, M. (1996), *Constructionism in Practice Designing, Thinking, and Learning in a Digital World*, NJ Lawrence Erlbaum Associates, Inc., Mahwah.

Kafai, Y.B., Fields, D.A. and Searle, K. (2014), "Electronic textiles as disruptive designs: supporting and challenging maker activities in schools", *Harvard Educational Review*, Vol. 84 No. 4, pp. 532-556.

Kirschner, P.A., Sweller, J. and Clark, R.E. (2006), "Why minimal guidance during instruction does not work: an analysis of the failure of constructivist discovery, problem-based, experiential, and inquiry-based teaching", *Educational Psychologist*, Vol. 41 No. 2, pp. 75-86.

Ladson-Billings, G. (1995), "Toward a theory of culturally relevant pedagogy", *American Educational Research Journal*, Vol. 32 No. 3, pp. 465-491.

Lee, C.D. (2003), "Toward a framework for culturally responsive design in multimedia computer environments: cultural modeling as a case", *Mind, Culture, and Activity*, Vol. 10 No. 1, pp. 42-61.

McLoughlin, C. (1999), "Culturally responsive technology use: developing an on-line community of learners", *British Journal of Educational Technology*, Vol. 30 No. 3, pp. 231-243.

Margolis, J., Ryoo, J.J., Sandoval, C.D., Lee, C., Goode, J. and Chapman, G. (2012), "Beyond access: broadening participation in high school computer science", *ACM Inroads*, Vol. 3 No. 4, pp. 72-78.

National Academies of Sciences, Engineering, and Medicine (2018), *How People Learn II: Learners, contexts, and Cultures*, The National Academies Press, Washington, DC.

Paulin, D. and Haythornthwaite, C. (2016), "Crowdsourcing the curriculum: redefining e-learning practices through peer-generated approaches", *The Information Society*, Vol. 32 No. 2, pp. 130-142.

Piaget, J. (1959), *The Language and Thought of the Child*, Psychology Press, Vol. 5.

Pinkard, N. (2001), "Reader and say say Oh playmate: using children's childhood songs as literacy scaffolds in computer-based learning environments", *Journal of Educational Computing Research*, 'Rappin', Vol. 25 No. 1, pp. 17-34.

Reynolds, R. (2016), "Defining, designing for, and measuring 'digital literacy' development in learners: a proposed framework", *Educational Technology Research & Development*, Vol. 64 No. 1, pp. 735-762.

Reynolds, R. and Hansen, P. (2018), "Inter-disciplinary research on inquiry and learning: information and learning sciences perspectives", *ACM SIGIR Conference on Human Information Interaction and Retrieval (CHIIR) 2018*, New Brunswick, NJ.

Reynolds, R. and Harel, I. (2019), "Building and scaling an e-Learning platform for constructionist CS education in America's school system: lessons learned during research and development of globaloria, 2006-2017", in Holbert N., Berland M. and Kafai Y.E. (Eds), *Constructionism in Context: The Art, theory, and Practice of Learning Designs*, MIT Press Cambridge, MA.

Reynolds, R. and Rieh, S.Y. (2017), "Information and learning sciences as an integral scholarly nexus. American society for information science and technology (ASIST) Conference 2017", *SIG InfoLearn pre-conference workshop*, Crystal City, VA.

Reynolds, R., Meyers, E., Ghosh, S. and Novin, A. (2018), "Beyond bloom's taxonomy: integrating 'Searching as learning' and e-learning research perspectives", *American Society for Information Science and Technology (ASIST) Conference 2018*, Vancouver BC, CA.

Reynolds, R., Meyers, E., Haythornthwaite, C. and Chu, S. (2018), "ASIS&T SIG InfoLearn pre-conference workshop: coordinating scholarship in searching as learning", *American Society for Information Science and Technology (ASIST) Conference 2018*, Vancouver BC, CA.

Rieh, S.Y., Collins-Thompson, K., Hansen, P. and Lee, H.J. (2016), "Towards searching as a learning process: a review of current perspectives and future directions", *Journal of Information Science*, Vol. 42 No. 1, pp. 19-34.

Rubel, A. and Jones, K.M.L. (2016), "Student privacy in learning analytics: an information ethics perspective", *The Information Society*, Vol. 32 No. 2, pp. 143-159.

Saracevic, T. (2009), "Information science", in Bates M.J. (Ed.), *Encyclopedia of Library and Information Sciences*, 3rd ed., New York, NY: Taylor and Francis, pp. 2570-2585.

Sawyer, R.K. (2014), "'Introduction: the new science of learning'", in Sawyer R.K. (Ed.), *The Cambridge Handbook of the Learning Sciences*, Cambridge University Press, pp. 1-20.

Scott, K.A., Sheridan, K.M. and Clark, K. (2015), "Culturally responsive computing: a theory revisited", *Learning, Media and Technology*, Vol. 40 No. 4, pp. 412-436.

Squire, K. (2007), "Games, learning, and society: building a field", *Educational Technology*, Vol. 4 No. 5, pp. 51-54.

Stager, G. (2001), "Computationally-rich constructionism and at-risk learners", *2001 World Conference on Computers in Education*, Copenhagen, Denmark.

Steinkuehler, C.A. (2006), "Why game (culture) studies now?", *Games and Culture*, Vol. 1 No. 1, pp. 97-102.

Sweller, J., Kirschner, P.A. and Clark, R.E. (2007), "Why minimally guided teaching techniques do not work: a reply to commentaries", *Educational Psychologist*, Vol. 42 No. 2, pp. 115-121.

United Nations (2016), "UN global sustainable development report, 2016", available at: https://sustainabledevelopment.un.org/index.php?page=view&type=400&nr=2328&menu=1515

Vavrus, M., (2008), "'Culturally responsive teaching'", in Good, T.L. (Ed.), *21st Century Education: A Reference Handbook*, Sage Publications, Los Angeles, Vol. 2, pp. 49-57.

Vygotsky, L.S. (1978), *Mind in Society: The Development of Higher Psychological Processes*, Harvard University Press, Cambridge, MA.

Wang, F. and Hannafin, M.J. (2005), "Design-based research and technology-enhanced learning environments", *Educational Technology Research and Development*, Vol. 53 No. 4, pp. 5-23.

Worsley, M. and Blikstein, P. (2013), "Designing for Diversely motivated learners", *Interactive Design for Children Conference (IDC) 2013*, Digital Fabrication and Making In Education Workshop, New York, NY.

Further reading

Kuhlthau, C.C. (1994), "Seeking meaning: a process approach to library and information services", *The Library Quarterly*, Vol. 64 No. 4, pp. 473-475.

Lee V.R. and Phillips A.L. (Eds) (2018), *Reconceptualizing Libraries: Perspectives from the Information and Learning Sciences*, Routledge, New York, NY.

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