EDITORIAL

Bridging the Extended Classroom: Social, Technological and Institutional Challenges

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The research presented in this special issue of *Nordic Journal of Digital Literacy* is framed by an interest in the ways in which the future classroom is increasingly conceptualized as extending beyond school walls. There are two perspectives on characteristics of the extended classroom that are particularly relevant to this framing. First, as networking systems allow near ubiquitous access to vast amounts of knowledge sources, curriculum may be conceived as a spatializing process (Nespor, 2000), with learning and boundaries between school and outside world 'performed' based on what sources students find relevant to the setting (Säljö, 2010). This agentive view on learning, linked to a groundswell of alternative multimodal resources, challenges knowledge practices in schools that continue to emphasize writing and reproducing information mainly based on textbooks (Säljö, 2010). To explore the lay of this digital landscape within which classrooms are situated, three articles in this issue present museum-related learning research. This is because the field of museum learning research, often overlooked in the education sciences, has contributed important insights into the problem of alternative sources and structures for 'informal learning' contexts for more than twenty-five years (DeWitt & Storksdieck, 2008; Falk & Dierking, 1992; Mortensen & Smart, 2007). Museums have also led the way in the innovative use of web-based, interactive, and mobile technologies to bridge learning activities across multiple contexts, including school, home, museum and community settings (Hawkey, 2004; Johnson, Witchey, Smith, Levine, & Haywood, 2010; Naismith, Lonsdale, Vavoula, & Sharples, 2006; Pierroux, 2001).

Emerging technologies leads to the second perspective on learning in the extended classroom addressed in this special issue. Interacting with multiple sources and complex knowledge representations, and productively communicating in the virtual realm of online learning environments, are challenges explored in detail in two of the articles. As students seek, find, and produce information and sources elsewhere for use in inquiry, the textbook, teacher, and school are increasingly losing the monopoly on disciplinary content. Among the vast amount of accessible resources are technological tools purposely designed to structure reflection and deep conceptual learning. Yet advancements in digital representations of scientific phenomena and mathematical procedures increasingly 'blackbox', or make invisible, operations and steps that were previously part of what it meant to 'learn how' to perform calculations and solve problems (Säljö, 2003). Therefore, structure is required on different levels, in the digital tools themselves but also in the institutional features of activities, to intervene and foster transactivity (Weinberger & Fischer, 2006) and collaborations that are productive for conceptual as well as procedural learning (Krange & Ludvigsen, 2008). Together, the collection of articles explores concepts and presents empirical studies of relationships between bodies, minds, and the design and use of digital technologies that are relevant for the extended classroom. The aim of this special issue is to present research that

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supplements more systematic surveys, trend descriptions, and scenarios pointing to the future of education (Facer & Sandford, 2010; Johnson, et al., 2010).

The Articles

Young people's experiences of technology outside of the classroom, in particular those relating to Web 2.0 and mobile technologies, are increasingly finding their own 'spaces' within the formal school setting. In a study by Clark (2009) of technologies that students 'can' but are 'not supposed to' use in the classroom, he finds that mobile phones, online chat and messaging applications, file sharing, and access to social networking or other Web 2.0 sites are most prevalent. However, the increasingly common circumvention of school rules against the use of some technologies also generates a sense of 'digital dissonance,' as learners and teachers deal with finding a balance between the social and educational affordances these offer (Clark, 2009). Introducing museum pedagogy and materials into a classroom context represents a similar challenge of trying to bridge discrepancies between multiple sources and learning activities in the public sphere and those in school (Pierroux, Krange, & Sem, 2011). School field trips, out-of-school learning activities, and travelling exhibitions are distinct approaches employed by museums in this bridging work, which is often enhanced by the pedagogical design and use of digital technologies. These respective approaches are discussed in three of the articles.

In the article by Lauren Giarratani et al., the design of 'organizational dynamics' for out-of-school learning activities that can foster and develop pre-teen girls' interest in science and technology is presented in the *Click!* project. In keeping with the premises of inquiry learning, real science-based issues in the community are introduced to students as problems to be investigated and solved, with the learning process modelled on experts' scientific methods (Bodemer et al., 2005). In this case, the role-playing involves adopting personas of investigators in the fictional Click! Agency, and multiple technology platforms are used to create a pervasive mixed reality gaming environment in the public sphere. Through participation in an extended learning community constructed in conversation with friends, families, and experts, the girls discovered the public sphere as both part of their everyday world and as an informal learning arena in which access to and performance of expert scientific concepts and knowledge is relevant and valued. In addition to the girls' changed perspectives on science and technology, the authors found a new awareness of peers' previously unrecognized skills and that science conversations continued at home, in their day-to-day living. As such, the study also provides insight into the complex construction of girls' and minorities' identities as someone who knows and does science, rather than as outsiders to the practice of science (Bouillion & Gomez, 2001).

The article by Rolf Steier and Palmyre Pierroux similarly investigates the development of conceptual understanding among adolescent students, as they participate in museum-related activities that span classroom and outdoor sites. Students are engaged in planning a new cultural center for their local environment, with both museum curator and classroom teacher involved in scaffolding the students' design and modelling activities. A central finding is the ways in which perception, the physical environment, and the use of digital and analogue resources mediate the young people's creative and explorative processes across social, physical, and institutional boundaries. As in the Click! study, the design of organizational dynamics and technology use are based on pedagogical principles for peer collaboration, multiple sources, and timely interventions by teacher and curator 'experts' in the disciplinary domain. These principles are drawn from the respective research fields of design (Schön, 1983), classroom studies (Cazden, 1988; Linell, 1998), and museum learning (Knutson & Crowley,

2010; Leinhardt & Knutson, 2004), and developed through a design partnership involving museum educators, architects, learning researchers, teachers, and students at different stages of development.

As the familiar sequence structure of acquiring resources, answering questions, and test-taking becomes less rigid in extended classroom contexts, students increasingly engage in (partially) self-directed learning, organizing processes and becoming more responsible for both learning and product outcomes. As in the projects described above, students are often invited to engage in investigations to discover and work out previously unknown 'real world' problems that exist in the community that are topical, relevant, and unsolved (Bouillion & Gomez, 2001). The aim of learning new scientific theories, formulas, and relationships is thus to produce a beneficial solution for a particular problem in the community. Anders Kluge reviews in his article this model of discovery learning in science, focusing on the structure of inquiry, the use of interactive media, and relations between experimentation and generation of hypothesises. Perspectives in interaction design frame the analysis, as Kluge investigates how these relate to inquiry learning research. Presenting two different examples of interactive models used for inquiry, the article illustrates the importance of students first exploring and becoming familiar with a technology in order to make the scientific knowledge relevant in their inquiry. Kluge finds that there are recurring tensions in the design of representations and structures for inquiry work, requiring a balance between the social aspects of specific settings, the interactive features in the technology, and student-led inquiry practices in which they are responsible for process and product. As 'regular school work' increasingly takes on characteristics of informal learning real-world inquiry, Kluge concludes that understanding tensions in situated use and deriving principles that are productive for discovery and collaborative learning are of primary design importance.

Design principles are further explored in the article by Armin Weinberger, who investigates means of supporting 'transactive' interactions in online learning environments from an instructional software design perspective. The concept of transactivity describes the potential of students to build on the reasoning of their peers when collaborating in problem solving using educational technologies. As such, these principles are relevant for learning both inside and outside classrooms when a teacher is not present, and can be applied to different disciplinary domains. In his review of computer-supported collaborative learning (CSCL) literature, Weinberger identifies five principles for designing scripts in educational technologies that can engage students in specific activities conducive to transactivity. These principles are related to those identified by Kluge, i.e., balancing social aspects, interactive features, and student-led inquiry practices, but also account for the special challenges of learning collaborations that are not face-to-face. Specifically, these principles include the design of particular features that induce awareness of other learners, coordinate learners' tasks and products, suggest and visualize certain procedural actions, and prompt the use of resources as needed.

These studies illustrate the need for interdisciplinary perspectives and 'mutual benefit partnerships' (Bouillion & Gomez, 2001) in designing and researching learning in the extended classroom. Challenges in multi-professional collaboration are the focus of the article by Cecilie Jahreie and Ingeborg Krange, who report on a start-up meeting from the MIRACLE project. This project aims to develop a more integrated and boundary-crossing approach to the design of technology-enhanced learning on science museum field trips. The start-up meeting invited discussion of the participants' respective perspectives and concepts of learning in schools and museums, with the voices of learning researchers, museum conservators, and exhibition designers represented. The authors point out that these two contexts are often conceptualized as quite distinct in the research. Using Activity Theory

(Engeström, 2007) as analytical tool, the authors present the different views on science learning that project partners bring to the collaborative design process, and describe how these perspectives create tensions in understandings of the object of the design activity. The study makes a theoretical and methodological contribution to research on the kinds of 'inside' tensions and competing interests that give form to science exhibitions and the digital learning environments that aim to bridge museum experiences with the classroom (Allen, 2004; Krange & Ludvigsen, 2008; Macdonald, 2002).

Research agenda for the extended classroom

Directly and indirectly, the articles in this special issue point to some of the social, technological and institutional challenges involved in bridging learning between classroom and informal learning contexts, or what we have called the extended classroom. We conclude by summarizing some of these challenges as they are described in this issue, reflecting on implications for future research. First, we note a parallel between informal learning contexts outside the classroom, which as Giarratani et al. point out lack organisational dynamics that give educators control, and the trend of using multiple technologies and sources inside school that challenge school practices and the textbook as a primary resource. In keeping with students' increased agency in activities of self-directed discovery and inquiry, there is the need for a better understanding of importance of access to multiple sources that support productive learning interactions through the design of different social, technological and institutional features.

Second, the articles point to a need for structure on multiple levels that foster learners' participation in solving real-world community-based problems, but which also support conceptual development in specific disciplinary domains. From a pedagogical design perspective on the extended classroom, this means that there is a need for exploration but also for disciplinary resources at the level of social interaction, in the technological tools, and in the organisational dynamics. Similar findings are made by Kluge and Weinberger in their studies of relevant principles for designing educational technologies for use in specific knowledge domains within and outside of classrooms.

The need for collaboration across multiple professions is the third theme addressed by several articles that is related to notions of the extended classroom. As Jahreie and Krange point out, participation across institutions and organizations, the exploratory use of technology, and inquiry approaches are agents of change in formal and informal learning institutions. Together, the collection of studies presented in this issue shed light on situated, participatory, and exploratory aspects of technology enhanced learning within and across settings. Such studies, when combined with more longitudinal research designs and methods, describe possible futures for technology-enhanced learning in the extended classroom setting.

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