A Wide Lens on Learning in a Networked Society: What Can We Learn by Synthesizing Multiple Research Perspectives?

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Abstract: Learning in a networked society is presented in this symposium with the basic assumption that "schooling" and "society" cannot be considered as separate entities and should bring together the theoretical and practical tools of scientists in both the social and educational sciences. Despite the powerful potential for cross-fostering of ideas between these fields, one key question arising inquires whether educational scientists—who focus on the interventionist, design-based study of learning—and social scientists, who concentrate on analytic study of spontaneous social interaction and knowledge construction, can engage in a productive collaboration. This symposium seeks to address this question by adopting an interdisciplinary lens, through which these perspectives have been integrated, or at least juxtaposed, to develop new insights regarding what it means to learn in an information-based networked society. Six interdisciplinary research projects that represent lessons learned from synergistic projects among researchers from these fields are presented in this symposium.

The overall focus of this symposium

We often associate computer-supported collaborative learning with specially designed tools for small group collaboration in formal learning settings. Yet, today's networked society, presents a broader and more diverse landscape of collaborative learning. In these diverse settings, the scale, scope and nature of learning is also expanded. In the past, people may have been in contact with members of various professional communities only as an audience, now, online interactions offer opportunities for collaboration with these professionals. Communities that may have been insular can be in greater contact with other communities and may change through this encounter. Are these sites of collaborative learning? How might we investigate whether and how learning occurs in such settings, and can this knowledge inform the design and study of CSCL in formal settings?

These changes in the landscape of computer-supported collaborative learning call for new theoretical lenses and methodological tools. The learning sciences have much to offer regarding the manner in which representations and participant structures can advance specific learning goals effectively. Yet, this understanding is mostly useful for explaining how learning occurs through hierarchical teacher-student interactions within existing school structures. Social scientists, on the other hand, offer a deep understanding of the ways in which

people use and adopt technologies in a variety of everyday contexts. Unlike much of the research in the learning sciences, they tend to observe without intervention as they examine various virtual communities that interact using social networking platforms (e.g., Facebook, Twitter) or Web 2.0 platforms (e.g., Wikis, Blogs).

We can gain inspiration on how to design learning environments and on how to interpret learner interactions in these settings from social scientists' research on how learning occurs incidentally within spontaneous online communities. At the same time, learning sciences research offers new directions for studying the learning that might occur in non-formal communities and as people adopt new technologies. In particular, it provides theoretical frameworks and methodological approaches for fine-grained analysis of the development of specific knowledge structures.

In this symposium, we present a set of six studies that were conducted as part the Learning in a NetworKed Society (LINKS) Center, all of which were studied with an interdisciplinary lens, through which these perspectives have been integrated, or at least juxtaposed, to develop new insights regarding what it means to learn in an information-based networked society. The set of studies we present here are part of the LINKS book, currently in press in Spriger's CSCL book series, who have granted permission to reuse parts of the chapters in this symposium. Christopher Hoadley, who is the editor of the series will serve as discussant in the symposium.

The symposium will be carried out as a structured poster session, starting with a rationale presented by the organizers (10 minutes), and brief introductions from each of the poster presenters (total of 15 minutes). This will be followed by concurrent poster interactions (30 minutes), remarks from the discussant (20 minutes), and finally, a discussion with the audience, facilitated by chair (15 minutes).

Theoretical background

Historically, there seems to have been a disconnect between in-school and out-of-school practices and experiences. This is evident both in terms of discourse patterns (Cazden & Beck, 2003), and in terms of knowledge goals, task characteristics and the motives for pursuing these tasks (e.g., Berland et al., 2015; Chinn & Malhotra, 2002). More recently, and more visible in the public's perception of formal schooling is the disconnect in the centrality and form of the use of technological tools (Selwyn, 2006). In some cases this disconnect can result in an underestimation of learners' capacity, and consequently in their inability to benefit from in-school activities for personal development and social mobility (Moje, 2000). In other cases, learners regard schooling with disdain, and are reluctant to embrace the curriculum deeply (Kolikant, 2009). Consequently, there is an increasing call for creating more permeability between in-school and out-of-school activities.

Similarly, processes of development and change at the individual, group and community level, as studied by anthropologists, sociologists, communication scholars, and other social scientists, other than a few notable exceptions (e.g., the work of Jean Lave (e.g., 1996)), have remained mostly outside the purview of learning scientists, and have not necessarily been considered as contributing to pedagogical theory. Yet, understanding the mechanisms that underlie some of these processes can help us understand classroom processes in new ways, or suggest novel approaches to designing and orchestrating in-school learning. For example, understanding how individual micromotives give rise to macrobehaviors (Schelling, 1978) can provide new insights on how the classroom as a whole might project different knowledge and attitudes toward learning than what might be found with individual students. Network analyses of online knowledge sharing, such as in Wikipedia or YouTube (Kumar et al., 2010) can provide insights on the ways in which useful knowledge and skills might be acquired in a bottom-up interest-based process, rather than a top-down curriculum.

Therefore, there is great promise in bringing together the theoretical lenses and methodological tools of social scientists and learning scientists to better understand how norms, dispositions, choices, skills and knowledge develop through technology-infused knowledge sharing and co-construction. This not only serves the long-term research goals of the CSCL community (Ludvigsen, Cress, Law, Rosé, & Stahl, 2016; Wise & Schwarz, 2017), but also serves to break down historical boundaries, and reconceive "schooling" and "society" as complementary spaces on a continuum. The papers in this symposium demonstrate the insights that can arise from juxtaposing and integrating these perspectives. The overall approach taken together by the papers in this symposium is a focus on an ongoing process of knowledge production through joint activity that can be distributed over time, space and context. It further examines new media rather than "educational" or "generic" tools per se.

Study 1 and 2 within this symposium examine the role of new media in putting the public in closer contact with science in informal and formal settings. In study 1, the indirect communication between the public and scientists and science reporters is examined from a critical perspective noting the ways in which new media enhances opportunities for knowledge growth, and the ways in which it might foster false notions of competence. Study 2—focused on science learners—integrates several bodies of literature to suggest designs for formal learning that could in the long run help mitigate the double edged sword alluded to in study 1.

Three studies, as a whole, suggest ways in which we might blur distinctions between formal and informal

collaboration, and how we might study collaboration as it occurs in more open and unstructured settings. Study 3 illustrates how grassroots ICT practices can challenge, subvert, and reshape existing norms and practices in insular communities, such as Ultra-Orthodox (Haredi) Jews in Israel. Study 4 explores how our growing understanding of such processes of technology-infused knowledge building in the wild can be used to create more open and dynamic learning spaces. Specifically, the ways in which a novel physical space can mediate knowledge production that occurs through movement between formal and informal contexts. Study 5 responds to the need for new ways of understanding complex interaction patterns and trajectories of ideas between points of interaction that collaboration in the wild and in future learning spaces demand. They present their approach of appending analytics to social learning to derive quantifiable measures of interactional patterns and use of learning resources that explain the resulting learning process.

Finally, study 6 adopts the combined perspective of educational and social science research to examine the broader implications of the types of research explored by the papers in this session. Drawing on Dewey's *Education and Democracy* (1916), this study considers how democratic values may be reflected in these new media configurations. Analyzing a case example, they exemplify how such new media might increase permeability between formal and informal spaces, allowing for designed and spontaneous learning.

Study 1. New media—A double-edged sword in public engagement with science
Ayelet Baram-Tsabari and Amit Schejter

Here we explore the special attributes of new media, compared with their "traditional" predecessors, in the context of public engagement with science online and specifically with informed decision making regarding science-related issues. Modern life requires adult individuals with little formal educational background in the sciences to make science and technology-based decisions, such as vaccinating one's children, consuming genetically modified food or buying a house near a nuclear power plant. The chief or sole information source for many such decisions is the internet, that became the public's primary reference database concerning science and technology (National Science Board, 2016; Israeli Ministry of Science, 2017). New media thus increasingly shape public engagement with science (Brossard, 2013; Brossard and Scheufele, 2013; Peters et al., 2014).

The new media landscape is characterized by an abundance of content and channels through which information travels, as well as by interactivity, mobility and multimediality (Schejter and Tirosh, 2016). New media have the potential to enrich information and make its transference more effective. We tackle both the benefits and the challenges of making informed decisions based on access to these media.

We attempt to combine two theoretical frameworks. The first concerns rules for deliberation, the need to ensure they are egalitarian and the goal of guaranteeing inclusion of that those who have been excluded from them— the least advantaged members of society based on Jürgen Habermas's model for deliberation and John Rawls and Amartya Sen's theories of justice. All should have an opportunity to express themselves, their needs and their desires, when such deliberation concerns science-related decisions. The second component concerns types of knowledge acquired in social interaction and the skills that are required to interpret them. We then sought to determine whether new media supports diverse audiences who do not possess the necessary expertise in each scientific field requiring everyday decisions, considering the unique characteristics of the relevant media. We found that new media constitute a double-edged sword and that each of their novel features can either boost or decrease knowledge levels as defined by Bloom (Anderson et al., 2001; Bloom et al., 1956).

We discuss the benefits and challenges of using new media for public engagement with science in the context of one's actual ability to use available online resources rather than simply having access to them. These skills concern both higher and lower thinking skills, as demonstrated in the context of four features of new media.

Study 2. Citizen science: Opportunities for learning in the networked society
Ornit Sagy, Yaela Golumbic, et al.

Seeking to promote science communication, civic engagement and informal education, citizen science is a genre of research that connects scientists and non-scientists around projects involving science. This meeting point creates opportunities for potential benefits to both sides. Scientists may advance their research, obtain prestigious funding and publish scientific papers (Golumbic, Baram-Tsabari, & Fishbain, 2017). Non-scientists (citizens) stand to gain enjoyment, community building, new skills and knowledge and hands-on understanding of scientific processes (e.g., Brossard, Lewenstein, & Bonney, 2005), important information about their local environment, and in some cases the means to influence policymakers. Although these outcomes are optimistic and inspiring, much work is still needed to understand how learning occurs within such collaborations, especially when citizen science is getting more focused on education and being put to schools (Hod, Sagy, Kali, & TCSS, 2018; NRC,

2018).

To shed light on learning processes of citizen science participants, we conceptualize citizen science and its myriad stakeholders as an ecology. Relationships between parties within the citizen science ecology refer to interactions among scientists, project participants, educational institutions, policymakers, etc. We complement the ecology metaphor with the term mutualism to express our desire for interactions in which all parties benefit from their involvement (Bronstein, 1994). With these two metaphors in mind, we propose a Mutualistic Ecology of Citizen Science (MECS) as an analytic framework that can potentially contribute to both conceptualization of learning in citizen science projects, as well as their design. To operationalize this framework, we use four lenses that span several disciplines to look at potential benefits to different participants: The *Learning Communities* lens provides a means for examining cultural and interactional processes involved in citizen science, with an eye on those interactions that promote learning and growth. The *Science Communication* lens reveals the power of citizen science as a vehicle to enhance the general public's understanding and engagement with science. The *Statistical Education and Data Science* lens aid the development of data literacy, that may be required and enhanced for citizen science participants. The *Science Education* lens is mostly relevant to formal education, as it is concerned with the promotion of scientific literacy.

Understanding the different ways citizen science projects benefit diverse participants is a vital step towards designing effective MECS that contribute to all who are involved in them. At the new Taking Citizen Science to School Research Center (Hod et al., 2018), we recently proposed an example for a MECS model based on the four lenses described above. The new model, Students as Citizen Science Ambassadors (Atias et al., 2017), integrates a citizen science program in a K-12 school as part of its formal science curriculum. Scientists worked closely with educational researchers and teachers to co-design curricular resources and student activities. These were designed to advance science and data literacies and engage students in communicating information to their close community by planning and executing project-related activities. This model is expected to intensify the mutualistic nature of citizen science; the students develop data and science literacies, as well as science communication skills, while being empowered to promote change in their own community. The community gains access to relevant scientific information and an option to contribute to scientific research. The scientists benefit from the students' acting as agents promoting public participation in their research, producing increased capacity for data collection and analysis, along with a well-informed, attentive audience.

Study 3. ICTs in religious communities: Communal and domestic integration of new media

Nakhi Mishol-Shauli, Malka Shacham, and Oren Golan

Since the 1990s, the integration of information and communication technologies (ICTs) into everyday life, including work, education, leisure and overall personal management, has become a hallmark of modern societies. Considering this development, British scholars (Horst, 2012; Silverstone & Haddon, 1996), established the domestication approach of technologies, contending that technological integration processes within modern families and communities are not technology-deterministic, but are largely affected by cultural and social factors. While these scholars explored modern-western populations' legitimation of new media, further nuanced investigation of ICT integration among communities that manifest strong ideological, cultural or religious objections to modern practice is required. Despite overall resistance, an apparent boost in internet and new media use by members of such communities has been recorded and described by researchers representing various disciplines (Busch, 2010; Horowitz, 2001). This study discusses the patterns and implications of ICTs domestication and use in Israel's ultra-Orthodox (Haredi) community.

While ICT use has been rejected from Haredi formal educational settings, it has been largely integrated into informal home and workplace settings. Considering the apprehension expressed by religious communities—especially enclaved and marginalized groups—regarding ICTs, as well as the opportunities they embody for these sectors, we question how do socializing agents in Haredi society negotiate ICT use within informal educational spheres. Haredi education has often been observed through its formal settings (Perry-Hazan, 2013). By contrast, we contend that an exploration of the domestication processes effected by families and online journalists can shed light on the impact of ambient or semi-structured learning environments on religious and bounded communities.

We focus on two key fields of engagement with ICTs: (1) An emergent mass communication venue, namely that of online journalism within the Haredi community, perceived as a type of informal education for adults that specializes in culture, norms and identity (McQuail, 2010) and (2) everyday engagements with personal computers by family members, including children, within the Haredi household. While household socialization of children is a widespread educational practice, we believe that the religious underpinnings attributed to modern and/or technological artifacts have not been accorded sufficient attention in contemporary research.

As engagement with ICTs increases, parents and educators often raise concerns over chaotic consumption of technologies in modern societies, lamenting the abundance and ubiquity of new media technologies to which youngsters are exposed from an early age and noting that such developments may disrupt their socialization and erode their value system (Clark, 2013; Selwyn, 2006). Although much of this discourse may be attributed to overall moral panic regarding technology (Cohen, 2011), we suggest that Western dominated scholarship in this field could benefit from the study of responses to new media among traditional groups, thereby acquiring an innovative viewpoint for reflection on new media integration in both modern and traditional societies.

While offering meaningful gains and opportunities towards bridging economic and digital divides, ICTs raise concern by such communities for potential rupture of cultural boundaries. Focusing on Israeli ultra-Orthodox Jewry, we inquire how grassroots socializing agents negotiate ICT usage within informal educational spheres for adults and children. Analyzing interviews and children's drawings, findings show that while ICTs are proscribed from formal ultra-Orthodox education and mass media, the home constitutes the epicenter of computer education for children, and web-journalism becomes a valued information outlet for adults. We detail how these agencies grapple with silencing efforts and challenge communal authority, posing an avenue for long-range identity and worldview changes.

Study 4. Future learning spaces: Exploring LINKS research perspectives

Yotam Hod, Keren Aridor et al.

The networked society has brought about dramatic changes to the way in which people learn. Among these changes, learning spaces have become a topic of immense interest. One does not need to look far to find this in public media, popular educational discourse, and large-scale school reforms (Hod, 2017). The 2016 Horizons report, one of the most comprehensive international reports on educational innovation, views the redesign of learning spaces as a main driver of educational change in the years to come (Adams Becker, et al., 2016). Yet, the billions of dollars allocated in recent years to implement large and expensive renovations to learning spaces at all levels of education, in both formal and informal settings, have by no means brought the desired outcomes. This is a challenge that calls for rigorous scholarship to further explore, understand, and guide this phenomenon (Ellis & Goodyear, 2016). To advance this goal, this chapter refines the relatively new notion of 'Future Learning Spaces' (FLSs: Sutherland & Fischer, 2014) via the unique prism of learning in the networked society.

Drawing on what is known about learning spaces from the past several decades of research, we analyze several LINKS-related examples to reveal and share new insights about this generative and timely concept. Specifically, we analyzed FLSs in learning communities (Connections, KCI-SC), in informal settings (Maketec Makerspace), and in medical centers using simulations (MSC: Medical Simulation Centers). As can be seen across these examples, FLSs allow many types of sophisticated pedagogies to be implemented, whether by supporting free-flowing activities (e.g., Connections and Maketec) or in more orchestrated and scripted designs (e.g., KCI-SC and MSC). Similarly, the learning process can be supported by different technologies such as in online spaces to gather community data with digital tools that facilitate the development of reasoning skills, physical devices that encourage creation, or video equipment used for self-reflection of learned skills. These can range from low-to high-tech solutions. Together with content areas that span statistical learning in elementary and middle schools, medical education during undergraduate and residency programs, and interdisciplinary topics in public spaces, there is a large range of span of diverse FLS designs, all of which share several core characteristics.

The diversity of FLS pedagogies and technologies provides exciting opportunities to apply 'innovation mindsets' towards the design of learning environments in a continually expanding endeavor. FLSs are a cornucopia of innovation – a testbed where a wide range of pedagogies and technologies can be combined and remixed, with few restrictions. FLSs thus provide a way forward for the design of educational environments. It is not coincidental that the Horizon report (2016) couples "rethinking how schools work" with "redesigning learning spaces". FLSs are at the forefront of an exciting period of development for learning in the networked society.

Study 5. A theoretically informed methodology for analytics of collaborative learning

Carmel Kent, Amit Rehavi and Sheizf Rafaeli

Extracting analytics based on digital traces and footprints from social platforms provides socio-computational opportunities and challenges alike. Beyond the ethical and privacy considerations (Pardo & Siemens, 2014), dilemmas surrounding any policy dependent on predefined performance indicators will accompany endeavors relating to learning assessment (Ellis, 2013), especially when based purely on online interactions. Despite these challenges, we perceive digital traces as a promising tool with which to access the rich world of online learning communities (Ferguson et al., 2014). We aim to join others who appended "analytics" to "social learning" and to

suggest that quantifiable interactional patterns, based on well-accepted social learning theories, should be considered as tools for the assessment of collaborative online learning.

Social learning analytics focus on how communities of learners co-create knowledge. MOOCs (Massive Open Online Courses) and other online learning endeavors are based on online conversations and enable rich logging data collection and data mining, based on learners' collaborative behavioral patterns (Sinha, 2014; Wu, Yao, Duan, Fan & Qu, 2016). At the same time, the absence of face-to-face interactions in online learning invites further analysis and research of online interactions. Specifically, our contribution to this symposium is to suggest a network analysis methodology for the assessment of the performance and design of learning communities.

As distant and blended learning play an increasingly central role, policies are required concerning the evaluation and assessment of individual and collective online learning. To jump-start this debate, we propose a set of quantifiable and scalable learning indicators, based on social network analysis, that we believe can complement traditional assessment tools. To develop such metrics, we suggest perceiving online discussions in learning communities as networks, in which both human agents and content posts are the nodes, while interactions among nodes are represented as edges. The collaborative learning process is thus regarded as the construction and growth of a network containing various types of interactions among learners and content items (AlDahdouh, Osório, & Caires, 2015). We demonstrate our proposition using a case study of a single higher education learning community that used online discussion in a blended mode during an entire academic semester, and show two assessment indicators for individual learning, and two for collective learning, both in the context of social learning.

Our results in the individual learner context suggest that in the course of online learning, creating connections with surrounding resources and co-learners, as well as being creative when doing so (proposing original tags for relations instead of choosing from a readymade dropdown list) are correlated with improved grades. Also, we show that learners involved in connecting detached information resources have special topological parameters and a high potential to contribute to community learning.

Our results in the collective context show that as learning evolves, the distances between the learners and discussed subjects become closer, contributing to the communal sharing of ideas and knowledge. We also show that the number of cliques (closed groups) grows concomitantly with the size of the network, buttressing the assumption that the presence of cliques supports the process of creating knowledge. Furthermore, we found evidence that the proportion of large cliques decreases as the network evolves, pointing to the emergence of additional opportunities to interact.

One possible future implication is the use of such aggregate indicators in providing measures at the course level, as well as in providing feedback to learners.

Study 6. Democracy, communication, and education in the 21st century

Adi Kidron, Noam Tirosh, Yael Kali and Amit Schejter

A century has gone by since John Dewey published Democracy and Education, positing that education "consists primarily in transmission through communication" (Dewey, 1916/2012, p. 13). The dramatic technological advancements that characterize our current networked society have shifted the ways that people communicate, educate and interact with each other. This work integrates notions from research on communication (social sciences) and socio-constructivist education in order to explore the new educational opportunities the networked society offers to enhance democratic processes for the benefit of society and its members. We focus on a specific case study – the LINKS courses – which aimed at supporting the development of students' interdisciplinary understanding of the LINKS theme. We designed an interdisciplinary curriculum and used a learning community (LC) approach that emphasizes collaborative knowledge advancement and the synthesis of diverse individual contributions as a means of personal learning as well as the learning of the whole community (Bielaczyc, Kapur and Collins, 2013). Building on the affordances of contemporary media – mobility, abundance, multimediality and interactivity (Schejter & Tirosh, 2016) – we designed technological features to embody our pedagogical rationale as a set of two parallel courses (for undergraduate and graduate students, respectively) offered four times between the years 2013 and 2017, at the University of Haifa.

To analyze the LINKS case study, we synthesised varied theoretical notions of democracy into four tenets: active participation, free movement of voices, equal and just expression, and ability to influence. Our perspective on socio-constructivist pedagogies is exemplified by four meta-level design-principles (Kali and Linn, 2008) that support meaning-making through knowledge integration: help students learn from each other, make contents accessible, make thinking visible, and promote autonomous lifelong learning.

Building on the tenets of democracy and the four design principles, our analysis shows how the different technology-enhanced features embodied discrete aspects of the democratic idea. It also shows how thoughtful and careful design, which took potential challenges and threats into consideration, led to the formation of a positive

learning environment in which these democratic ideas were fulfilled to promote students' learning and interdisciplinary understanding. For example, to ensure the voicing of those who are mostly silenced ('equal and just expression' tenet), students received encouraging feedback from the course moderators ('make contents accessible' design principle). Another important aspect of free expression in the courses was the safe environment, constructed through learning community norm prompts presented to the students on different occasions and via various channels. Interactions between the graduate and undergraduate parallel courses allowed knowledge to be "shared among the many, rather than being exclusively the preserve of the few" (Jay, 1984). Knowledge authority was not reserved for teachers alone since no one expert had all the disciplinary answers. Collaborative knowledge-building activities encouraged students to participate in a public discussion thereby strengthening the 'ability to influence' tenet. Technology guaranteed the 'free movement of voices' and enabled inclusion of all students in the community to participate equally without the need to struggle for the right of expression.

To summarize, we argue that since interdisciplinary understanding allows for more than one sole truth, it has the potential to promote democratic notions. Furthermore, a learning community approach is democratic by nature, as it builds on active expression of individual interests to promote shared ones. Finally, in face of varied possible threats (as described in Study 1), contemporary media's added value to democratic processes is not obvious and only careful design of the way these media are used, especially in the context of educational interventions, can lead to positive change and a better future in terms of democracy and education.

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