Networked by Design: Interventions for Teachers to Develop Social Capital

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Abstract: Previous research on the use of social network analysis in education has demonstrated how the methodology can reveal patterns of interactions that enable the sharing of resources. For more than a decade, we have read about the promise that building networks can bring in terms of enacting instructional improvement. However, few studies have aimed at reporting on the designs and enactments of intentional structures for building teachers' social capital through the development of social networks. Even fewer have discussed the deliberate mechanisms and methodologies used in the interventions. In this structured poster symposium, we present six current efforts in building teachers' social capital with an emphasis on *what* this work is and *how* it is done. This group of researchers work with a variety of teacher populations both in formal and informal environments to solve important issues in the building of educational and teaching capacities.

Introduction

In 1975, Lortie provided an in-depth picture of teaching as an isolated, technical job in his seminal book, *School Teacher*. Since then, the concept of teaching has shifted where collaboration and inquiry are celebrated and working alongside fellow professionals in professional development activities is a central goal (Blandford, 2012; Lieberman & Mace, 2008). In addition to acquiring human capital, teachers are expected to develop their social capital via participation in communities of practice and networking (Lovett & Cameron, 2011). Social capital, defined as capacities developed through direct and indirect relationships in social networks (Coleman, 1988), has been a focus of scholarship in understanding educational change, particularly through studies of social networks. The concept of social capital has provided educational researchers and practitioners with valuable perspectives on patterns in social interaction and relationships that impact productivity, resource management, community building, organizational trust, and intervention dissemination (Bryk & Schneider, 2002; Penuel et al., 2013). Over the last decade and a half, Social capital and social network research in education has risen steadily. For example, between 2005 and 2010, the number of studies on social networks in schools increased ten-fold (Daly, 2010).

Mainly through survey and interview data, social network studies in education have revealed insights about how teachers access expertise, the efficacy of leadership structures, how advice, professional, and personal networks support teaching, and why and how school reforms spread through districts (De Laat & Schreurs, 2013; Leana & Pil, 2006; Spillane & Hopkins, 2015; Yoon et al., 2017). This critical mass of research on the potential for social capital and social networks to impact educational contexts has encouraged scholars and school leaders to move toward researching and designing interventions informed by this research. However, few studies exist about these interventions, how they have been implemented, what mechanisms promote change, and importantly, how the interventions have improved teaching and learning. We need to have clear models and strategies of those interventions that work. In this presentation, we aim to provide a range of specific, real-world examples of social

capital and social network professional development interventions and their outcomes from macro-level (e.g., district-wide) to micro-level (e.g., communities of practice) interventions.

Symposium organization

The participants in this symposium have been intentionally selected for the range of research in social network and social capital interventions so that audience members can witness the broad applicability and impactful nature of these theories in multiple teacher education contexts. The content of the presentations vary along research characteristics such as population size and scale (e.g., multi-state cross-school networks to case studies of a preservice course), knowledge domains (e.g., complex systems to mathematics content), and formal and informal settings (e.g., elementary school teaching to afterschool digital learning). They also vary in terms of the mechanisms used to construct social ties and capital such as intentional rewiring, working in the open, and integrating instructional coaches. However, they are all similar in working from the underlying assumptions that social network and social capital interventions provide access to expertise, resources, trust, common instructional goals, common language, and a moral purpose for improving the status quo. The goal of this structured poster symposium is for audience members to walk away with a tangible set of strategies they can immediately put into place with the macro or micro-level populations that they work with. The following session organization will be used:

1. Welcome and introduction by session chair (3 min)
2. Two-minute summaries of individual poster presentations in the large group (12 min)
3. Small group poster rotations (50 min)
4. Large group panel discussion (25 min)

In the large group discussion, we will address questions from the audience and then move to discussing the common affordances and challenges of doing social network and social capital research in various contexts and at various scales.

Symposium participants and study summaries

Building networks to support effective use of science curriculum materials in the *Carbon TIME* Project

William R. Penuel, University of Colorado Boulder; Elizabeth de los Santos, University of Colorado Boulder; Qinyun Lin, University of Colorado Boulder; Stefanie Marshall, Michigan State University; Charles W. Anderson, Michigan State University; and Kenneth A. Frank, Michigan State University

An enduring challenge in science education is how best to support effective use of curriculum materials. The potential of high-quality curriculum materials to support student learning in science is well documented (Furtak, Seidel, Iverson, & Briggs; 2012). Curriculum materials provide a "toolkit" that teachers use to support classroom instruction (Remillard, 2005). Teachers and students use these tools in different ways that are consequential for the quality of student learning. Some adaptations may enhance learning when they result in curricular experiences that are a better fit to student needs and local policy contexts (e.g., Penuel, Gallagher, & Moorthy, 2011). Other adaptations may diminish the potential of curriculum materials (e.g., Lynch, Szesze, Pyke, & Kuipers, 2007). A central challenge for the field is to support teachers in making adaptations to materials to fit their local contexts better, while still maintaining integrity to the principles that underlie the design of coherent science curriculum materials (DeBarger, Choppin, Beauvineau, & Moorthy, 2013). Developers of such materials, for their part, also need ways that teacher feedback and adaptations can inform subsequent revisions to make them more usable in a wider range of contexts.

This presentation explores one set of strategies for supporting such adaptations: building and supporting social networks comprised of teachers, curriculum developers, and researchers, some of whom are experts with knowledge of both curriculum and local contexts. The project that is the context for the presentation is focused on supporting effective use of a set of science curriculum materials called *Carbon: Transformations in Matter and Energy*, or *Carbon TIME*. A team led at Michigan State University developed the materials to support student development along a set of empirically validated learning progressions for carbon cycling and energy flow in socio-ecological systems (Jin & Anderson, 2012; Mohan, Chen, & Anderson, 2009). In the current National Science Foundation-funded project, which is organized as a DBIR project focused on the effective use of the materials, the network structure consists of cross-school networks in three states, led and facilitated by researchers,

curriculum developers, and professional development staff at multiple universities. These networks are designed to promote interactions between teachers and provide opportunities for teacher participants to interact with people with significant expertise in the curriculum materials. The aim is to directly influence how teachers use the curriculum materials in their classrooms through network activities, which in turn reshapes a third network, namely that of students and teacher(s) in the classroom.

In this presentation, we discuss the theoretical framework we are using in our project. Then, we describe how these theories have informed the design of network activities and our research. In the concluding part of the presentation, we present some initial high-level findings from the first two years of our research.

Open source culture as inspiration for design of educator learning networks

Rafi Santo, New York University

Open source culture and the notion of 'open networks' has led to important shifts in the ways that learning, collaboration and invention occur in fields ranging from science (Nielson, 2012) to journalism (Gillmor, 2004) to business (Chesbrough, 2006). However, there is limited work that has explored how education might leverage ideas of open networks and associated open work practices. While the movement to promote development of Open Educational Resources (OECD, 2007) has drawn on open source culture to argue for more extensible and available educational materials, it's conception of 'open' has focused on the 'content' of education - curricula, assessments, syllabi - but has not actively looked at the practices of open learning and design by collectives of educators. Such exploration is worthwhile, especially given the increasing downwards pressure on teachers in the age of accountability, associated deprofessionalization and decreasing valuation of educator creativity and collaboration. The open work practices described in this presentation provide a needed contrast to these trends in the professional life of educators.

This presentation explores how a designed organizational network of over 70 informal learning organizations, Mozilla Hive NYC Learning Network, drew on open source cultural practices as a means to promote socially driven collaborative learning among its educators. Hive NYC includes major cultural institutions such as Carnegie Hall and the American Museum of Natural History, the city's library systems and parks department, grassroots community-based organizations such as Dreamyard and the Brooklyn College Community Partnership and other youth-serving nonprofits that focus on particular pedagogical approaches and specialties like the Institute of Play, Global Action Project, the LAMP, Beam Center, and Iridescent. Member organizations develop learning initiatives around web and game design, film and music production, informal science, "maker" education, journalism, youth organizing, media and digital literacies, coding and electronics, and other emerging digital technologies. At the same time, they share a common interest in promoting youth pathways with technology and exploring new pedagogies enabled by technology.

I advance the notion of "Working in the Open" (Santo, Ching, Peppler & Hoadley, 2014; 2016), a set of work practices that value transparency, an experimental stance and open contribution, and I argue that it represents a departure from existing industrial influences of scientific management and Taylorism in education. I'll discuss five core practices associated with "working open" - (1) *Public Storytelling and Context Setting*, (2) *Rapid Prototyping "in the Wild"*, (3) *Enabling Community Contribution*, (4) *Public Reflection and Documentation* and, lastly, (5) *Creating Remixable Work Products*, and will share how these practices are distinctive in their emphasis on promoting open participation in learning and design activities within networks of educators. Following this, I'll share how Hive NYC stewards supported educators in the network to engage in working open practices both through enculturation and modeling these practices and through providing a consistent 'platform' of participation structures where educators could work openly with one another.

Designing Educational Infrastructures for Improvement: Instructional coaching and professional learning communities

James P. Spillane, Northwestern University Megan Hopkins, University of California, San Diego; and Matthew Shirrell, George Washington University

The US education system is at a crossroads in its efforts to facilitate teacher professional learning that supports instructional improvement. Given that teacher quality is the greatest predictor of student achievement, federal accountability policy as well as state and local teacher evaluation policies over at least the last decade have focused much attention on measuring teachers' performance. Pressure to improve individual teacher performance has been particularly acute in schools deemed underperforming as measured by students' scores on standardized tests of achievement (e.g., Diamond & Spillane, 2004). In response, many reform efforts have concentrated on supporting

teachers' professional learning via "sit and get" professional development or one-on-one coaching, in the hopes that, over time, these reforms will foster improvement on a larger scale (e.g., Mangin & Dunsmore, 2015).

Such efforts, however, overlook an essential component of teacher professional learning—social relationships, or what sociologists refer to as social capital; that is, the resources for action that reside in the relations among people (Coleman, 1988). Social relationships afford access to resources like information, advice, expertise, materials, and trust that can facilitate positive change in teachers' beliefs and practices (e.g., Daly, Moolenaar, Bolivar, & Burke, 2010; Penuel, Frank, Sun, Kim, & Singleton, 2013), and support valued school processes and outcomes like teacher commitment and student achievement (Goddard, Goddard, & Tschannen-Moran, 2007; Leana & Pil, 2006). Given that supporting social capital development is related to positive outcomes for both individual teachers and schools, it is critical that school and system leaders attend to and support teachers' social relationships as they undertake the complex work of teaching.

A growing body of scholarship seeks to identify the mechanisms that facilitate social relationships between teachers, pointing to various features of the educational infrastructure that support social capital development in schools, such as grade-level assignment and formal leadership positions (Spillane, Hopkins, & Sweet, 2015). Nonetheless, normative dimensions are also critical for facilitating social relationships (Hopkins & Spillane, 2015), where teachers in schools with shared norms such as trust and collective responsibility are more likely to interact about instruction in ways that enable its improvement (Bryk & Schnieder, 2002). Yet to be fully understood, however, is *how* these features of the educational infrastructure facilitate change in teachers' practices, both the work practices they engage in as they interact with one another about instruction as well as their classroom practices, especially in contexts where teachers are under pressure to improve.

In this presentation, we explore one school district's intentional efforts to design an educational infrastructure that fostered collaboration among teachers in its lowest performing elementary schools at a time of mathematics curricular reform, and examine the ways in which this infrastructure shaped teachers' interactions and classroom practices. We will show how the integration of instructional coaches and the redesign of an organizational routine focused on teacher collaboration (i.e., Professional Learning Communities, or PLCs) worked in tandem to facilitate teachers' interactions around the implementation of an inquiry-oriented mathematics curriculum. We also show how these features of the district's infrastructure facilitated changes in teachers' practices over time, such that their work practices as well as their reported classroom practices came to approximate those in the highest performing schools in the district.

Stimulating teachers' learning in networks: Awareness, ability, and appreciation

Femke Nijland, Open University of The Netherlands; Daniël van Amersfoort, University of Glasgow; Bieke Schreurs, PXL University College; and Maarten de Laat, University of Wollongong

Learning in networks is receiving increased attention in Dutch primary education. It is perceived as a way to stimulate teachers professional development (Vaessen, Beemt, & De Laat, 2014) and to provide teachers with the opportunity to regulate their own professional development in line with their professional needs (De Laat & Schreurs, 2013). In education, such alignment is particularly important since teachers often perceive their professional development as unrelated to their classroom practice (Lieberman & Pointer Mace, 2008). In addition, learning in networks is believed to lead to a more efficient flow of complex knowledge and routine information within the organization (Coburn, Mata, & Choi, 2013), stimulate innovative behavior (Coburn et al., 2013; Moolenaar, Daly, & Sleegers, 2010) and result in a higher job satisfaction (Lovett & Cameron, 2011). In this respect learning in networks can be perceived as an effective approach to for both professional and organizational development.

In this presentation, we report on a three-phased mode 2 research (Nowotny, Scott, & Gibbons, 2003) intervention for stimulating teachers' learning in face-to-face learning networks at a between school level. The intervention was informed by insights from literature on what works in learning in networks, and was developed in close cooperation with the participating teachers and principals. The main aim of the project was to study how learning networks could emerge, building upon the informal social networks already in place within the organization. We did so by creating awareness of learning in networks, by offering tools for the development of networking abilities that facilitate learning in networks, and by providing insight in the usefulness of these activities for the appreciation of their value creation. Our intention was to accompany participating teachers and principals on a journey into the what, the how and the why of learning in networks. The main question answered in this project is: *How does stimulating awareness, developing networking ability and offering insight into the outcomes of learning in learning networks, contribute to learning in social networks for professional development within an organization for primary education?*

We report on eight learning networks that were established between five schools, resulting in more learning ties between teachers, new perspectives for participating teachers on the nature of learning and an overall greater recognition of the emancipatory role of networked learning.

Mechanisms that couple intentional network rewiring and teacher learning to develop teachers' social capital for implementing computer-supported complex systems curricula

Susan A. Yoon, University of Pennsylvania

Complex systems can be found in structures and behaviors in all aspects of our world—from nanoscale networks to cities, ecosystems, and climates. Scientists have focused on investigating and managing issues related to complex systems that impact our lives, such as the spread of disease, power grid robustness, and biosphere sustainability (National Academies, 2009). Likewise, the recent Next Generation Science Standards (NGSS) highlight crosscutting concepts that reflect important aspects of complex systems (e.g., scale, structure and function, stability and change). Classroom interventions based on software that model complex systems, such as StarLogo and NetLogo (Klopfer et al., 2009; Wilensky & Rand, 2015), have also been created along with accompanying curricula that can be implemented in the science classroom (Yoon et al., 2016). This heightened emphasis on complex systems in educational policy and resources raises challenges for educators who must teach to the NGSS. In a review of the educational literature (Yoon, Goh, & Park, in press), we found a dearth of studies on both teacher learning about complex systems and how best to support teachers in professional development (PD). Furthermore, we know that the success of the NGSS is contingent on the quality of teaching, yet these standards require substantial shifts in teaching practice (Wilson, 2013). And it is widely known that the lack of high-quality PD opportunities make adopting reforms challenging (Blandford, 2012). We need more information about how to develop pedagogical content knowledge and curricula with respect to complex systems in PD activities that are aligned with teacher learning and classroom practice (Yoon et al., 2015).

For several years our research team has focused on addressing this major gap in complex systems research. Initial efforts in PD were predominantly aimed at developing teachers' knowledge and skills of computational modeling, complex systems, and scientific practices to support curricular integration (Yoon et al., 2017a). Such efforts in building knowledge and skills in individuals can be considered developing human capital (i.e., increasing personal capabilities that enable people to act in new ways; Coleman, 1988). Due to the complex nature of teacher learning and instructional orchestration, however, we came to understand the necessity of building opportunities for teachers to interact about problems of practice and to share implementation strategies as they emerged. Thus, our emphasis shifted in later PD activities to building teachers' social capital (i.e., capacities developed through direct and indirect relationships in social networks; Coleman, 1988).

In this presentation, we discuss a 2-year design and development study that was part of a project called *BioGraph: Graphical Programming for Constructing Complex Systems Understanding in Biology*, funded by the U.S. National Science Foundation from 2010 to 2015. The goal of the project was to create teaching and learning resources for high school classrooms centered on the use and construction of computational agent-based models of biological systems. We will begin with highlighting differences in human capital and social capital foci between the first and second years of PD and implementation. We will then describe our theory of change based on strategies of *intentional rewiring* (Valente, 2012) that are tightly coupled with theories of teacher learning–these strategies are: *seeding interactions* to improve tie quality; *birds of a feather* to improve depth of interactions; *targeted problems of practice* to improve trust and motivation to share; and *expertise transparency* to improve access to expert practice. We conclude with details about improvements in teachers' confidence levels that were primarily influenced by their network activities in the second year.

Translating the Connected Learning framework for teacher educators: Lessons from the field

Kira Baker-Doyle, Latricia Whitfield, and Katie Miller, Arcadia University

In the last 20 years, global digital connectivity has given rise to a "networked era," (Castells, 1996), in which individuals can connect easily across distances, sharing news, stories, and ideas. As such it has changed our ability to access resources and information in social networks, and, some would argue, has mediated cultural practices of communication (Jenkins, 2006; Wesch, 2009). Connected Learning is a relatively new framework for learning that aims to broaden educational opportunities and equity during this era through fostering socially embedded, interest-driven networks of learning in and outside of the classroom. (Ito et al., 2013). The framework was

developed by a team of researchers and practitioners at the Digital Media Learning Lab at MIT between 2010-2013, and has proliferated mainly through grant-funded educational programs for out-of-school youth. The core principles of Connected Learning focus on developing learners' social capital to gain greater equity and opportunity in education.

Recent social network studies in education have shown that teachers benefit from strategically building professional support networks (Moolenaar, Sleegers, & Daly, 2012; Van Waes, Van den Bossche, Moolenaar, De Maeyer, & Van Petegem, 2015), therefore, Connected Learning has the potential to serve as an important framework for teaching pre-service teachers how to build professional networks of support and improve their practice. Yet, since its inception the Connected Learning framework has mainly been studied in out-of-school learning organizations, such as the Digital Youth Network, which applied the framework to design an effort to foster connections between STEM afterschool programs across Chicago, IL (Barron, Gomez, Martin, & Pinkard, 2014). As such, there in a crucial gap in research on how the Connected Learning framework can be (or has been) used to design teacher education (Baker-Doyle, Mirra, Trust & Lohnes-Watulak, 2017). To address this gap, we examined the experiences of graduate education students (pre-service and in-service teachers) in a course that was designed on the principles of Connected Learning, and also taught the graduate students about how to use the Connected Learning principles to design their own future classrooms. This presentation reports on findings from Year 1 of a three-year longitudinal study.

The Connected Learning framework consists of three learning principles and three design principles (which we elaborate upon in the literature review). We decided to examine one design principle of Connected Learning in our analysis of Year 1 data: engagement in "production-centered" or "making" activities. We sought to study the participants primarily as learners, in how they used and made sense of activities and practices based on this principle of production-centered learning. Furthermore, since the core focus of Connected Learning is on building social capital, we wanted to know how these activities might serve to foster social capital. Ultimately, this study provides insight into how a teacher education program can teach strategic social networking, and how the Connected Learning framework in particular supports this aim.

Thus, our research questions were: What does engagement in "production-centered" learning activities look like in a teacher education course? How do learners' participation in these practices change over time? And, what are recurrent themes relating to social capital development that emerge through production-centered learning experiences? In this presentation, we discuss lessons for teacher educators that seek to translate the Connected Learning framework into their practice and curricula to promote strategic social networking for professional growth.

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