Designing for the Next Generation of Teaching Practices with a Networked Improvement Community (NIC): A longitudinal study of local adaptation and improvement

Abstract: In this related paper set we share 5 papers from a five-year research-practice partnership project in which university science and English Language educational researchers partnered secondary science teachers, coaches, principals, and district leaders from a culturally and linguistically diverse school district to develop a Networked Improvement Community that aims to improve science instruction for all students, and EL students in particular. Currently educational systems are not designed to adapt or improve instruction, but this project represents a shift in how knowledge has traditionally been used in education, particularly in professional learning. We describe the application of NIC principles through three inter-related levels of participants and their interdependent activities, which supports the improvement of instruction, and "getting better at getting better."

Objective: In this related paper set we share 5 papers from a five-year research-practice partnership project in which university science and English Language educational researchers partnered secondary science teachers, coaches, principals, and district leaders from a culturally and linguistically diverse school district to develop a Networked Improvement Community that aims to improve science instruction for all students, and EL students in particular.

Overview: Currently educational systems are not designed to adapt or improve instruction, rather they are designed to adopt and distribute "best practices." The process of dissemination positions educational researchers as knowledge-holders and practitioners as knowledge-receivers and are typically top-down approaches in which teachers are given little time to interpret new instructional practices, and professional development takes place outside of the classroom walls with little to no focus on local adaptation or innovation. Bryk et al. (2011, p. 5) argue that NICs help systems "test, refine and transform practitioner knowledge into a professional knowledge base in education."

Structure: In this session, we will share findings from three inter-related levels of the NIC, the A, B, and C levels (Englebart, 1992), which support the improvement of instruction, and "getting better at getting better."

The first paper will describe findings from the "A" level in our model is the classroom where teachers and students use a variety of tools and other resources to mediate learning directly.

The next three papers examine B-level activity; organizational efforts that are designed to improve the on-the-ground work. We describe findings from implementing a job-embedded professional development model district-wide, which focuses on improving a set of research-based science teaching practices using a lesson study-type approach. We describe how local improvement network (LIN) with clusters of teachers, coaches, principals, and educational researchers and collaboratively improved teaching and learning practices over 5 years at 8 schools.

The fifth paper uses Social Networking analysis to examine C-level activity and the capacity for learning across schools. We describe mechanisms central to the movement of tools, and shared teaching practices across the Network.

Each paper will have 10 minutes to present, then a discussant with expertise in research-practice partnerships and NICs will provide his perspective on the learnings from this project in relation to others around the country. We will then have 30minutes for discussion with participants. We recognize this session will draw from multiple lines of educational research and thus will break the group into 3 groups (one for each level of the NIC). For the last 5-10minutes we will reconvene to report out about the conversations and reason across levels about NICs and possibilities for improving instruction at scale.

Significance: This project represents a shift in how knowledge has traditionally been used in education, particularly in professional learning frameworks. This project is one of the first in the country to apply NIC principles to the improvement of instruction, and report on 5 years of data.

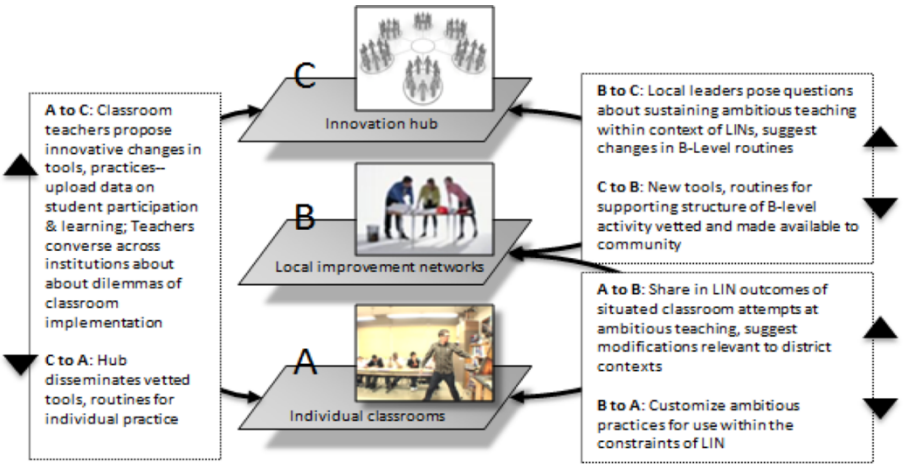


Figure 1. Activity within the Networked Improvement Community

PAPER 1 A-level
Teachers' Pedagogical Frames about Scientific Modeling: Being Developed through Collective Inquiry and Guiding Classroom Teaching

Purpose: The Next Generation Science Standards [NGSS] require K-12 students to participate in core practices of science, such as scientific modeling. Teachers' pedagogical frames about scientific modeling—understandings and beliefs about what scientific modeling is and how to support students' scientific modeling— are crucial in shaping teachers' discourses and practices in modeling-based instructions.

Framework: This research is grounded in a socially situated approach to learning, which puts forth that meaning is constructed through interaction in social settings (Greeno, 2006). Three bodies of research informed this study: scientific modeling (Authors, 2006; Lehrer & Schauble, 2006; Schwarz, 2009), teacher framing (Goffman, 1974) and professional learning communities (Coburn, 2001; Horn, 2005). How teachers frame student learning, teaching, and subject matter can guide what they notice, how they interpret, and how they act when they interact in professional learning communities and classrooms. In this study, we focus on teachers' pedagogical frames about scientific modeling to explore their understandings and expectations about modeling-based teaching.

Methods: We used a case study approach to examine 10 full-day professional development sessions where teachers, researchers and coaches collectively planned, implemented, and debriefed modeling lessons.

Data Sources: Video of 10 PLC days and teacher interviews.

Results: From the analysis, we identified a shift in the teachers' frames about modeling and found that their collective inquiry guided and was shaped by their frames. The teachers' frames about modeling influenced what they noticed about students' modeling, how they made instructional decisions, and how they facilitated students' modeling in classrooms. In the first year of the study teachers regarded scientific modeling as a summative activity for students to put the already-learned knowledge pieces together in the correct manner. Based on this frame, the teachers focused more on the content of scientific ideas that they expected to see in students' models rather than the students' ideas or explanations. They perceived their role as providing enough knowledge pieces beforehand so pieces could be applied during modeling. In classrooms during the full-day PD, they often tried to guide students to put certain scientific ideas at certain parts of models, rather than being responsive to the students' thoughts. After one year, the teachers gradually started to focus more on causal relations in students' models and framed modeling as *students'* construction of explanations about phenomena. They discussed how to support students' knowledge building processes and combined supports for scientific modeling with other pedagogical moves such as supporting English language learners.

The teachers' inquiry developed as the teachers' pedagogical frames about modeling evolved over time and shifted from a focus on modifying scaffolds to facilitating *all* students' rigorous

and equitable participation in scientific modeling. Researchers, coaches also shifted from leading inquiry to being co-inquirers.

Significance: This study suggests that A and B-levels of learning in the NIC are tightly interwoven and shifts can be understood through investigating teachers' pedagogical frames which cross settings (in teacher communities and classrooms). Our findings also suggest the importance of PLCs designed to engage in collective reasoning about instruction and core disciplinary practices through cycles of inquiry.

PAPER 2 B-level
English Learner-focused Teacher Leaders and Instructional Capacity Building

Purpose: As educators continue to grapple with providing English learner (EL) students access to rigorous, grade-level appropriate curriculum and instruction (Bunch, 2013; Lucas, Villegas, & Freedson-Gonzalez, 2008) in subjects such as science (Lee, Quinn, & Valdés, 2013), research-practice partnerships organized as NICs may help advance our understanding of professional development (PD) models that best support teacher and student learning. This paper examines the critical roles English learner-focused teacher leaders played in building secondary science teachers' instructional capacity in urban schools.

A few studies have shown that instructional coaching focused on instruction of EL students strongly influences mainstream classroom teacher pedagogy (Teemant, 2010), implementation of instructional approaches for EL students (Chien, 2013), and raising teachers' expectations of EL students (Batt, 2010). Yet, most design studies focus primarily on coaching the implementation of generalized frameworks of instruction, such as the Sheltered Instruction Observation Protocol (Echevarría, Vogt, & Short, 2013), excluding a deeper examination of the development of content-specific EL instructional practices.

Framework: We draw on two key ideas from teacher leadership research: (1) Teacher leaders are instructional leaders, who guide and support *ongoing* teacher professional learning for continued instructional improvement (Mangin & Stoelinga, 2008) and improved student learning, and (2) teacher learning and EL instructional change occur in relation to the cultural practices and social networks in districts and schools (Coburn & Russell, 2008).

Methods: This study reports on two years of full day PLC meetings for 6 schools in the network. EL coaches and university teacher educators collaborated with 46 teachers in secondary schools to co-plan, co-teach and co-debrief science lessons. We use a professional learning model similar to lesson study and coded for instances of EL-related talk.

Data Sources: We identified 136 instances of instructional teams explicitly discussing EL students and/or instruction for ELs. Instances ranged in duration from 20 seconds to 20 minutes of talk.

Results: We show how both English learner (EL) and science teacher leaders created more intentional spaces for embedding EL issues both during and in-between job- and classroom-

embedded professional development These teacher leaders supported the development of hybrid EL-science practices and instructional tools that addressed both science and academic language learning. Critical to this work was collaboration between EL and science coaches in planning studios and lessons. Deeper attention to ELs was given through the design of tools, intentional situating of studios in EL-heavy contexts, and planning specific teacher learning opportunities around EL considerations. These collaborations also allowed science teachers with EL expertise to emerge as teacher leaders, beginning to lead the EL-focused work. This study holds important implications for supporting mainstream classroom teachers in integrating EL and science instructional practices in rigorous and concrete ways, and contributes to our understanding of how high-leverage practices can be improved through the work of collaborative partnerships.

Significance: This paper adds to the growing body of research on understanding the work of teacher leaders in facilitating instructional change through PLCs, particularly for growing numbers of culturally and linguistically diverse students in mainstream classrooms.

PAPER 3 B-level
Positive Patterns of Principal Participation that Promote Reform Practice Enactment

Purpose: Leveraging iterative, inductive, qualitative analysis, this paper explores the degree to which principals integrated the science reform with their views of other school priorities and how that impacted the extent of opportunities available to teachers to work with reform practices. The more often principals co-participated with teachers in making sense of reform practices in the context of classroom enactments, the more likely principals were to employ a broader array of school leadership practices to support the reform enactment, and the greater the extent to which teachers engaged and became proficient with the reform practices. This study provides additional details outlining contextual factors at play in determining how principals' sense-making and school leadership practices influenced reform enactments.

Framework: This study builds on Fullan & Quinn's ideas about coherent practices (2016) and Spillane's (2015) articulated links between the sphere of administrative practice with instruction by examining specific administrative practices (Leithwood, 2012), principals' sense-making about reform practices, and the impact on teacher enactment of discipline-specific instructional reform.

Methods: I applied a multiple case study qualitative analysis to investigate how principals and assistant principals made sense of an initiative to reform science instructional practices and how that sense-making translated to school leadership practices, ultimately influencing the enactment of the science instructional reform in their buildings.

Data Sources: Principal discussions/interviews, instructional walk conversations, and principal surveys provided the primary data to examine principals' sense-making about the reform. Principal and coach interviews, teacher and principal surveys, and principal learning walk discussions provided data about school leadership practices, including principals'

interactions with teachers. Data about engagement with reform yielded primarily from teacher surveys and researcher logs of studio days, classroom observations, and data meetings.

Results: Key findings from this study include the importance of principals attending to the ongoing process of setting, adjusting and reinforcing direction through all of their leadership practices in ways that help to align both vision and practices around instructional change. Arguably the most significant element in helping to align direction and practices with the reform efforts was ongoing development of principals' own capacities through co-participation in reform activities at the core of instructional practices. Additionally, collaboration time for teachers and greater alignment with instructional coach supports contributed substantially to more extensive and proficient reform enactments.

Significance: These findings help to explain how and why particular school leadership practices reinforce or reduce the barriers of influence caused by loose coupling (Elmore, 2000) between leadership practices and instruction. This study exposes the ongoing cycle of direction setting that all leadership practices, regardless of intent, contribute to, by reinforcing, connecting, supporting or marginalizing particular priorities. This study provides further evidence into why Fullan & Quinn's (2016) push towards focusing on advancing the learning and practices of the group, and not just the individuals in it, further contributes to the cycle of direction setting. Additionally, it reinforces the need for school leaders to participate as lead learners, particularly with respect to the impact of such co-participation on establishing a more coherent system to promote instructional change.

PAPER 4 B/C level
Networked Professional Learning Communities, Improving Teaching Together

Purpose: Professional learning communities (PLCs) can be powerful vehicles for supporting learning and instructional improvement, but the quality of discourse often varies across PLCs and influences their effectiveness. This paper takes an improvement science perspective to study the discourse and improvement work of PLCs operating as part of a Networked Improvement Community (NIC). We describe how the discourse within PLCs that quickly generated and iterated on instructional practices differed from PLCs that struggled to do so, and we explore the role that the NIC played in supporting improvement across PLCs.

Framework: We draw on ideas from improvement science and collective knowledge generation as they are applied in the context of educational systems (Bryk et al., 2011; Bryk et al., 2015; Lewis, 2015). They describe "learning loops for quality improvement" (Bryk et al., 2015, p. 90) which highlight the importance of working theory, standard work processes, and practical measurement as co-constitutive elements of improvement. We practicably translate these elements for our instructionally-focused NIC (Figure 1).

Methods: For this study, we examined activities and interrelationships among three PLCs within the NIC -- two that quickly took up the work of generating and testing practices, and one that struggled to get started. Researchers and district coaches facilitated full-day PLC meetings, similar to lesson study.

Data Sources: Video records and artifacts from full-day PLC meetings, for two years, at three schools (Table 1). We used Studiocode to analyze interactions relating to the learning loop.

Results: *How did the discourse within PLCs that quickly generated and tested ideas for improvement differ from PLCs that struggled to do so?* Looking across PLC meetings from the first year, we saw two consistent patterns that distinguished the two PLCs that quickly took up improvement work from the PLC that struggled to do so. First, both generative PLCs, were able to identify something within the broader aim of the project to work on together. In contrast, teachers at Washington wrestled with multiple foci. The second pattern centered on a particular interconnection among discursive elements in PLCs' discourse. In short, the key interconnection that seemed to support generative PLCs in launching improvement work was linking talk about instructional practice to talk about classroom data. (See Figures 2 and 3.)

What role(s) did the NIC play in supporting improvement across PLCs? The second year of PLCs tells a different story for Washington as they made connections between practice and data. We argue that knowledge movement within the NIC played a central role. Through C-level activities (i.e. convenings) Washington adopted the practice of *Structured Talk* developed at Douglas. Having an initial practice and a way to look at classroom data helped Washington launch into localized improvement work.

Significance: This study contributes to our understanding of critical forms of discourse that enable PLCs to launch improvement work, and demonstrates how networked PLCs can improve together. In particular, we believe that practices like *Structured Talk* can serve as "foothold practices" in a NIC -- accessible, bite-sized practices that can be implemented regularly, and that draw attention to both equity and rigor in student learning.

PAPER 5 C-level
Longitudinal SNA of a Networked Improvement Community (NIC) Supporting Ambitious and Equitable Teaching Practice

Purpose: Applying principles for the development of a NIC (Bryk et al., 2015), researchers partnered with teams of teachers, coaches and principals from eight secondary schools to improve a set of evidence-based science teaching practices and school and district-based professional learning structures. The project began in a few schools then expanded district wide to all secondary schools. While many schools experienced an initial increase in students' standardized test scores (grades 8 and 10), schools that participated for 4 years experienced steady gains in scores. More importantly, teachers began working with one another to improve rigorous and responsive classroom teaching practices. This paper describes the social network that supported these learnings.

Framework: Within a NIC, knowledge travels through at least three mechanisms: through people, tools and tool use, and joint engagement within designed settings that bring different stakeholders together (Bryk et al., 2011; Coburn, 2003). Social Network Analysis is a

methodological approach that examines ties among individuals in networks ties and can indicate the impacts of newly engineered social structures and tools that support these interactions.

Methods: The NIC grew from two to eight schools and the types of networked activities across the network expanded. Each school participated in full-day Professional Learning Communities (PLCs). To support the network, we ran convenings, summer academies and workshops.

Data Sources: Science teachers, coaches, and researchers (N=21) were surveyed annually on who they seek advice from to improve science instruction. Longitudinal, quantitative social network analyses using separable temporal exponential random graph modeling (STERGM) was employed to analyze the network data (adjacency matrices). School membership was accounted for in the model. STERGM considers the formation and dissolution of ties (relationships between two individuals) across timepoints, rather than at one time.

Results: Network descriptive statistics are provided in Table 2 and sociograms across years in Figure 4. STERGM results showed that the formation of ties over time were lower than expected by chance (*formation edge* coeff=-5.04, SE=0.14, $p < 0.001$). However, once a tie within the network was formed, there were significantly greater reciprocal ties (mutual relationships) than would be expected by chance (*reciprocal tie* coeff=1.43, SE=0.31, $p < 0.001$), as well as significantly more ties forming in the same school (*ties in same school* coeff=2.21, SE=0.19, $p < 0.001$). Across the network measurement occasions, there was a negative dissolution edge estimate, indicating a significant proportion of ties dissolved less than would be expected by chance (*edge* coeff =-0.88, SE=0.31, p=0.005). Additionally, reciprocal ties were significantly likely to persist once a tie had been formed (*reciprocal tie* coeff=1.34, SE=0.60, p=0.028). Last but not least, ties within a given school were likely to remain consistent (the estimate was close to zero) (*ties in same school*=0.42, SE=0.37, p=0.258).

Scholarly significance: Findings from this longitudinal social network analysis show how the network changed over time. Of practical importance, we found that, although most teachers networked with individuals in their own schools, those relationships appeared to have significant persistence, which bodes well for links with practice.

Figures and Tables

Figure 1: Improvement learning loop for NIC focused on instruction

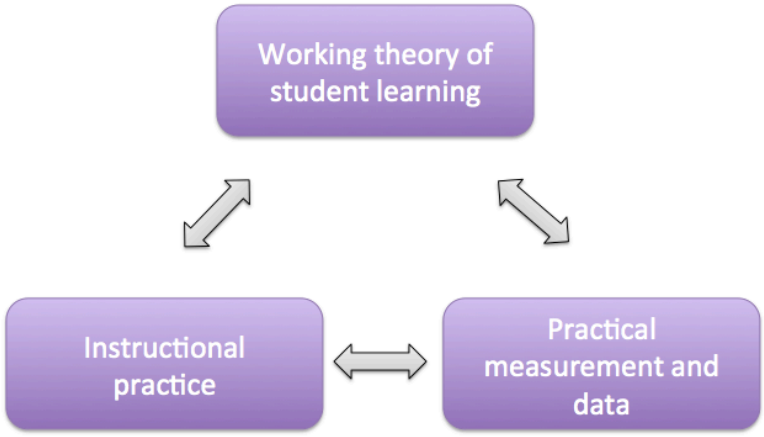


Table 1: Demographics of selected PLCs

School	Demographics (from 2013-14 academic year, first year of district-wide NIC)	Regular Composition of PLC on SDs
Douglas Middle School (quick start)	Number of students: 582 Student race/ethnicity: Hispanic/Latino: 42.9% Black/African American: 15.3% White: 14.6% Asian: 13.7% Native Hawaiian/Pacific Islander: 8.1% Two or more races: 4.6% American Indian/Alaskan Native: 0.9% Free or reduced-price meals: 81.3% Students classified transitional bilingual: 23.4%	4 science teachers 1-2 district science specialists 1 district EL specialist 3-5 university researchers (science and EL) School administrator
Kennedy High School Campus (quick start)	Number of students: 875 Student race/ethnicity: Hispanic/Latino: 40.2% Asian: 25.3% White: 14.5% Black/African American: 11.5% Two or more races: 7.9% Native Hawaiian/Pacific Islander: 5.1% American Indian/Alaskan Native: 1.4% Free or reduced-price meals: 79% Students classified transitional bilingual: 11.4%	6 science teachers 1-2 district science specialists 1 district EL specialist 3-5 university researchers (science and EL)
Washington High School (challenging start)	Number of students: 1256 Student race/ethnicity: Hispanic/Latino: 37.4% White: 27.9%	7 science teachers 1-2 district science specialists 1 district EL specialist 3-5 university researchers

	Asian: 11.5% Black/African American: 9.4% Two or more races: 8.7% Native Hawaiian/Pacific Islander: 3.6% American Indian/Alaskan Native: 1.3% Free or reduced-price meals: 63.6% Students classified transitional bilingual: 8.4%	(science and EL)

Figure 2: Coded 7-minute segment from first SD at Douglas

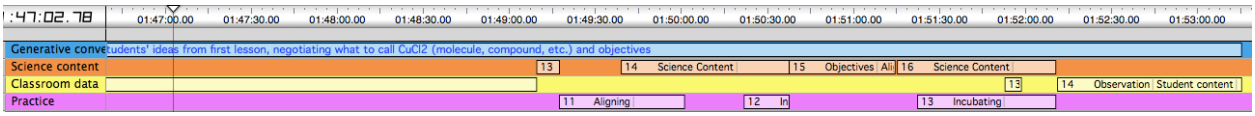


Figure 3: Coded 28-minute segment from fourth SD at Kennedy

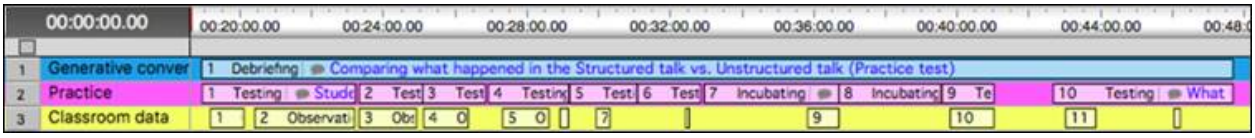
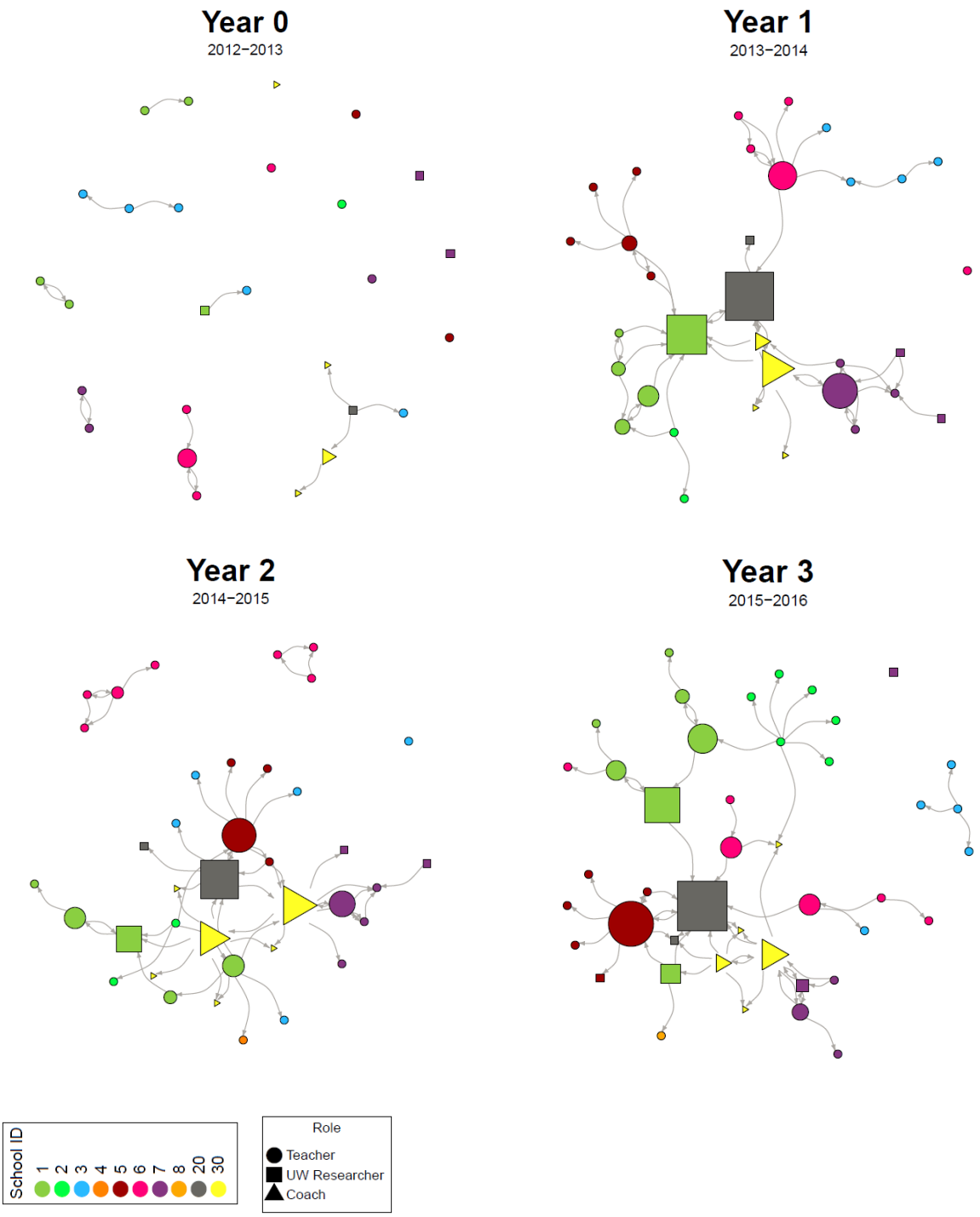


Table 2. *Social Network Descriptive Statistics*

Time Point	Nodes	Ties	Density	Reciprocity	Distance	Diameter
Year 0 (2012-13)	27	15	0.02	0.40	1.12	2.00
Year 1 (2013-14)	33	53	0.05	0.34	2.64	6.00
Year 2 (2014-15)	38	56	0.04	0.18	2.44	6.00
Year 3 (2015-16)	43	61	0.03	0.26	2.50	5.00

Figure 4. Sociograms for Each Year of NIC Social Network


Year 0
2012–2013
Year 1
2013–2014
Year 2
2014–2015
Year 3
2015–2016
School ID
1
2
3
4
5
6
7
8
20
30
Role
Teacher
UW Researcher
Coach

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