

DIFUSIÓN DE LA INNOVACIÓN: LA RED SOCIAL Y EL ENFOQUE DE APRENDIZAJE ORGANIZATIVO PARA LA GOBERNANZA DE UN EQUIPO DE LIDERAZGO DE TODO EL DISTRITO

DIFFUSION OF INNOVATION: A SOCIAL NETWORK AND ORGANIZATIONAL LEARNING APPROACH TO GOVERNANCE OF A DISTRICTWIDE LEADERSHIP TEAM

DIFUSÃO DE INOVAÇÃO: UMA REDE SOCIAL E UMA APROXIMAÇÃO DA APRENDIZAGEM ORGANIZATIVA DE GOVERNO DE UMA EQUIPE DE LIDERANÇA DE UM DISTRITO

Yi-Hwa LIOU* & Alan J. DALY**

*National Taipei University of Education, **University of California, San Diego

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<p>KEYWORDS: social networks innovative climate organizational learning governance leadership</p>	<p>ABSTRACT: District and school leaders play particularly important roles in leading districtwide improvement, as they are increasingly held accountable for bringing about change and improvement for educational innovation and excellence. While conventional districtwide governance places much of its focus on technical and administrative matters such as policy development, supervision, and monitoring progress. This technical focus often overlooks the fundamental aspect that drives the progress of improvement—the social infrastructure shaped by interpersonal relationship. Responding to recent scholarships that calls for a networked approach to governance, this study examined the change effort of a districtwide leadership team over three points in time drawing on social network theory and analysis focused on district governance. Specifically, we focused on the type of interpersonal relationship in which leaders engaged with each other in sharing and exchanging innovative ideas as these efforts may support better governance. Additionally, we explored organizational learning as a way to examine climate in support of districtwide innovative efforts during change process. Our findings from leaders indicated increased innovative behaviors and perceived climate on organizational learning over time. The findings suggested that leaders increased connections around risk taking, regardless of their work level over time. This increased connectedness around innovation was coupled with an increase in leaders' perception of the district's learning climate, suggesting a cohesive approach to governance and improvement.</p>
<p>PALABRAS CLAVE: redes sociales clima innovador aprendizaje organizacional gobernanza liderazgo</p>	<p>RESUMEN: Los líderes de distrito y las escuelas son esenciales para guiar las mejoras del todo distrito, ya que cada vez generan más cambios y mejoras para la innovación educativa y la excelencia. Mientras que la gobernanza del distrito convencional se centra básicamente en cuestiones técnicas y administrativas como el desarrollo de políticas, supervisión y el seguimiento del progreso. En muchas ocasiones este enfoque técnico deja de lado la base que impulsa a la mejora; la infraestructura social formada por las relaciones interpersonales. En respuesta a los últimos itinerarios universitarios que reclaman una aproximación en red a la gobernanza, este estudio examinó el esfuerzo de cambio de un equipo directivo de un distrito en tres puntos en el tiempo basándose en la teoría de redes sociales y el análisis centrado en la gobernanza del distrito. Nos centramos principalmente en el tipo de relación interpersonal con líderes comprometidos para compartir e intercambiar</p>

CONTACT WITH THE AUTHORS: Department of Educational Management. National Taipei University of Education.No. 134, Sec. 2, Heping E. Rd, Taipei 10671. Taiwan. E-mail: yihwa.liou@gmail.com, yhliou@tea.ntue.edu.tw

	<p>ideas innovadoras y cómo estos esfuerzos pueden apoyar una mejor gobernanza. Además, se analizó el aprendizaje organizacional como una forma de examinar el clima para apoyar los esfuerzos innovadores de todo el distrito durante el proceso de cambio. Los resultados que extrajimos de los líderes indican que con el paso del tiempo se produce un incremento de comportamientos innovadores y una mejora del clima percibido en aprendizaje organizacional. Los resultados sugirieron que con el tiempo los líderes incrementaron las conexiones corriendo riesgos, independientemente de su nivel de trabajo. Esta creciente conectividad en innovación coincidió con un aumento en la percepción del clima de aprendizaje del distrito por parte de los líderes, lo que sugiere una aproximación coherente a la gobernanza y mejora.</p>
<p>PALAVRAS-CHAVE: redes sociais, clima inovador, aprendizagem organizativa, governo e liderança</p>	<p>RESUMO: Os líderes de um distrito e de um colégio possuem papéis particularmente importantes na hora de defender a melhoria dos distritos, já que se conta cada vez mais com eles para aproximar a mudança e para melhorar a inovação e excelência educativa. Enquanto que o governo convencional dos distritos se centra, sobre tudo, em assuntos técnicos e administrativos como a política de desenvolvimento, supervisão e a monitoração do progresso. Este enfoque técnico normalmente passa por alto o aspecto fundamental que orienta o progresso de melhorar a infraestrutura social moldada pela relação interpessoal. Em resposta a recentes aportações académicas que sugerem uma aproximação em rede a maneira de governar, este estudo examina o esforço de câmbio de uma equipe de liderança distrital sobre três pontos no tempo que se servem da teoria das redes sociais a análise centrada no governo de distrito. Em particular, nos centramos no tipo de relação interpessoal na qual os líderes se relacionam entre si compartilhando e intercambiando ideias inovadoras, já que estes esforços podem supor um melhor governo. Ademais, exploramos a aprendizagem organizativa como uma via para examinar o ambiente com o apoio dos esforços inovadores distritais durante o processo de câmbio. Nossas descobertas, a partir dos líderes, indicaram que os comportamentos inovadores cresceram e perceberam um clima de aprendizagem organizativo ao longo do tempo. As descobertas surgiram por os líderes aumentaram as conexões através da tomada de riscos, independientemente do nível de seu trabalho ao longo do tempo. Este incremento da conexão em torno da inovação foi conjugada com o incremento da percepção dos líderes sobre o clima de aprendizagem do distrito, sugerindo uma aproximação coesa ao governo e a melhoria.</p>

1. Introduction

The role of educational leadership in educational reform is critical. National reform initiatives in the United States (USA), from the No Child Left Behind (NCLB, 2002) to the current Common Core State Standards (National Governors Association Center for Best Practices & Council of Chief State School Officers 2010), have been casting unprecedented pressures and consequences directly on educational leaders such as superintendents, school principals, and/or school boards (Weinbaum, Weiss & Beaver, 2012). District and school leaders are increasingly held accountable for bringing about change and improvement and closing the learning gap between students from diverse economic, linguistic, and culture backgrounds. With limited knowledge and resources available for implementing the new standards, leaders struggle with building local capacities of the districts to provide sufficient and relevant support for instructional change (Polikoff, Marsh, Plank, Hall, Hardaway & Le, 2014). Such a reform push has also reinforced a major shift in our thinking about key aspects in the work of leadership and governance at the district and school levels (Liou, Grigg & Halverson, 2014).

Conventional governance generally involves the focus on the role of stakeholders and board mem-

bers in various aspects of steering organizations such as setting a vision/goals, creating a climate, developing policy, monitoring progress, etc. (Anthes, 2002; Johnson, 2012). While this broad array of works is important, it overlooks the common core aspect that drives the progress of improvement—relational aspect. Recent scholarships call for a network approach to governance (Howlett, 2014; Vidovich & Currie, 2012). This network approach is critical as it attends to the fundamental relational aspect of governance necessary for improvement (e.g., communication and interaction within and between units). To our knowledge, there is a scant amount of research that investigates this relational phenomenon in district governance. Further, as the task for improvement is ongoing and cyclic, this study examines the change effort of a districtwide leadership team over time drawing on theory of social network approach to understanding relational aspect of district governance. We use social network concepts, data, and analysis to explore the relational aspect of governance in hopes to shed new light on this promising network approach to leadership and governance. Specifically, we focus on the type of interpersonal relationship in which leaders engage with each other in sharing and exchanging innovative ideas as these innovative efforts may steer the decisions for better governance (Sliwka, 2003; Stojkovi & Stefanovi, 2011). Finally, we

present concepts and data of organizational learning to indicate the level of districtwide climate in support of innovative efforts during change process.

2. Framework

2.1. Network Approach to Governance

District governance is not a new concept in educational leadership, having been discussed by scholars, practitioners, and policymakers as one of the organizational routines necessary for a district to continue. The concept while appearing to be commonplace to educational systems in the US has not been thoroughly defined and well documented by empirical work. For instance, Carver defines the notion of governance as “the process by which a small group of people, usually on behalf of others, exercise authority over an organization” (2000, p. 26). Others echo with this definition by addressing the transferability of those who possess power and authority to those less empowered to achieve common goals (Golarz & Golarz, 1995). In education a stated common goal of governance is to ultimately improve student outcomes (Galway, Sheppard, Wiens & Brown, 2013; Luckin & Sharp, 2004). Despite the various definitions, the majority of earlier works focus on a more narrowed range of roles in governing educational organizations such as superintendents and school boards (Cox & Malone, 2001; Quinn & Dawson, 2011). Beyond these more traditional roles we have limited knowledge as to the linkage between district administrators and school site principals in terms of district governance and direction setting despite mounting studies suggesting the importance of this team network approach to reform.

The current governance literature in education generally address the technical aspect of the governing figures such as identifying problems and goals, adopting strategies, raising resources, monitoring service delivery, and supervising accountability (Anthes, 2002; Wehling, 2007). While this aspect of tasks and responsibilities is essential in governing a school district, it oftentimes fails to fully characterize the nature of work that is both necessary and executed by district leaders. Although the tasks of identifying issues and setting strategies seem clear enough, these are complex undertakings requiring communication and interaction between and among individuals across difference units/levels of the organization. Overlooking this relational aspect may limit our understanding of successful governance in school district and what it takes to get reform work done. Previous work identifies barriers to communication between different levels of hierarchy in the district (Cox & Malone,

2001), which potentially leads to job dissatisfaction and high turnover (Alsbury, 2003). Attending to the relational linkages between individuals from different levels within an organization may therefore help address potential turnover of educational administrators and in turn strengthen the sustained development and governance of a district (Daly, Finnigan & Liou, 2014).

Finally, as educational reform/improvement is challenging work and requires the district to undertake an innovative approach to change (Daly & Finnigan, 2011), the established relationships and resources within the district may no longer be sufficient to meet demands of dynamic challenges (Liou, 2015). It takes innovative thinking and approaches to developing new linkages that may not only supplement the importance of established ties but also generate new social capital (Baker, 2014) through diverse input and relationships. Literature on school/district governance suggests a more relational focus on governance is associated with higher student achievement due in part to a climate of trust among board members, providing structured opportunities for regular discussion around vision and goals of the district, and ensuring smooth flow of information and access to support on a daily basis (Boeck, 2009; Delagardelle, 2008; Johnson, 2012). This line of literature resonates with the global attention to the 21st century educational leadership calling for a socially connected and innovative approach to leading and learning (Organisation for Economic Co-operation and Development [OECD], 2013). While these principles reflect the importance of connecting others in building school-district relations in addition to the board-district ties (Johnson, 2012), the idea of relational aspect in school/district governance and its potential contribution to organizational learning have not yet been well documented. In addressing the gaps in practice and research we draw from social network concepts to describe key aspects of a social network governance structure in support of improvement.

2.3. Relational Aspect of Social Network and Organizational Learning

Social network theory is generally concerned with the pattern of relational ties between individuals that are embedded in a social network (Scott, 2000). This definition underlines two important aspects of social networks: relational and structural. The relational aspect focuses on the importance and influence of relational ties by which individual social capital can be developed (Kilduff & Tsai, 2003; Lin, 2009; Liou & Daly, 2014). Relational ties in this sense are regarded as multiple channels and opportunities in which resources (e.g., ideas, knowledge, and information) can be exchanged between

actors travel across the network (Lin, 2009). Individual actors thus may benefit from the exchange of resources and as a result develop and/or accumulate social capital assets (Liou, Daly, Brown & Del Fresno, 2015).

This view of relational ties and its relation to social capital assumes that relational resources are inherent in preexisting and established ties between actors (Baker, 2014). However, organizations that are learning-oriented tend to possess greater capacity to generate and digest new ideas through new or diverse ties with others (Looney, 2009) such that preexisting knowledge may be better exploited through the exploration of new knowledge (March, 1991). The established ties and social capital may in turn transform into a new type of social capital formed by incorporating existing ties with new relationships (Baker, 2014). The combination of existing and new implies a greater attention to the capacity of educational leaders to be risk takers and to initiate innovative changes for systemic improvement (Looney, 2009).

In an organizational sense, organizations with climates that are open to innovation, in which members are willing to take risks and experiment with strategies as well as continuously learn to improve the organization are more successful at implementing actual innovations than organizations with less innovative climates (McLean, 2005). In addition, cultivating an innovative climate involves a cyclic social learning process that emphasizes norms of ongoing social interaction through which members exchange new ideas and practices, transform the existing knowledge and skills, and in turn make informed decisions (Frank, Zhao & Borman, 2004). Researchers have emphasized the importance of an innovative climate in school and the broader school system that supports the generation, implementation, and transformation of new practices for sustainable improvement (Daly, Liou & Brown, accepted; Daly, Liou & Moolenaar, 2014; Van Der Vegt, Van De Vliert & Huang, 2005). However, very few studies examine the type of innovative behavior in a district leadership team as they work to govern a system. Given the recent reform challenge and a call for an innovative and network-driven approach to governance, understanding how leaders connect with each other for innovation may provide useful insights into the type of relational ties necessary for organizational learning.

2.3. Structural Aspect of Social Network and Organizational Learning

The structural aspect of social network addresses the underlying pattern of relational ties between individual actors in a social network and the af-

fordances and constraints of the structure on the flow of relational resources and the accumulation of social capital (Burt, 1992; Coleman, 1990; Lin, 2009; Liou & Daly, 2014). Social network theorists posit that dense network structures facilitate the efficiency of resource flow as it takes less amount of time for relational resources (e.g., knowledge and information) to move from one actor to another (Burt, 1992). In contrast, sparsely connected network may generate lag in time in transmitting information and resources from actor to actor across the network due to fewer ties and more disconnected actors (Burt, 1992). Network researchers suggest that densely connected network may result in increased productivity, higher levels of innovation, and improved organizational functioning than those with sparse connections (Kilduff & Tsai, 2003; Liou et al., 2015; Moolenaar & Slegers, 2010). However, it should be also noted that dense structures may also entail potential closure of network in which information shared between actors is more likely redundant and may result in stagnant in innovation (Burt, 1992). On the other hand, networks that are less dense may contain more structural holes (lack of ties between actors) in which novel and non-redundant information is likely to be brokered between loosely connected actors, which in turn may generate advantages for connected actors to span their relationships (Burt, 1992).

The concept of network structure is critical in understanding organizational change as the change processes involve a series of learning and the exchange of innovative ideas for which various network structures may facilitate or constrain (Cross, Borgatti & Parker, 2002). In organizational sense, a balance between exploitation (utilization of existing knowledge) and exploration (discovery of new knowledge) of knowledge is desired for the adaptability of organizations (March, 1991). As knowledge is developed and conveyed through interactions, understanding the structure for knowledge transmission is key to organizational learning. In this regard, organizations that foster double-loop learning, as opposed to single-loop learning, tend to have the capacity to actively monitor and correct problems that impede learning in ways that involve the modification of the organization's underlying norms, values, and beliefs (Argyris & Schön, 1976). Through constant detection and modification, organizations are better able to self-renew into a new state of being with improved adaptability to change (March, 1991). Organization studies suggest that organizations that are open to innovation and learning tend to be more productive as they are willing to take risks on new strategies and are able to keep adjusting and reorganizing their course of action (Stojkovi & Stefanovi, 2011). Taken together, network structure and organizational learn-

ing play complementary roles in improvement and governance that each adds to the other supporting an overall climate that leverages knowledge development through relational linkages.

In sum, relational ties and resulting network structures are consequential in supporting and constraining the exchange and development of knowledge, practice (Spillane, Kim & Frank, 2012), and organizational effectiveness (Cross, Ehrlich, Dawson & Helferich, 2008). This study attempts to address this research inquiry into relational aspect of governance and its innovative efforts in districtwide reform by exploring relational ties and network structure of both district and school leaders regarding the exchange of innovative ideas in support of leadership practices and effective governance. The purpose of this study is twofold:

1. to understand the overall pattern of relational ties among and between leaders regarding their innovative behavior over time as they work toward networked governance; and
2. to explore the change in the network pattern regarding leaders' innovative behavior and perceived organizational learning over time as they work toward networked governance.

3. Study Design

3.1. Sample and Context

This study uses a case study design (Yin, 2013) that focuses on one school district that serves approximately 22,000 PK-12 students with diverse demographic backgrounds. The district provides a rep-

resentative case of districts in California USA (most populous state in US) as it reflects the demographic composition of schools across the state. Approximately 60% of the students are Hispanic and less than one third of the students are White. More than half of the students are qualified for free and reduced price lunch and about a third of the students are English learners. Over the last three years, the district has been undergoing a transformation in its leadership, missions, values, and goals with a strong focus on building collaborative relationships among and between school/district community members in an effort to support student learning and co-govern. Upon the adoption of new standards in 2013, the district's leadership team has endeavored to align its reform efforts with the goal of better collaboration to meet reform goals. It is in this context that we examine professional relationships around work-related innovation that may bear on the district's improvement efforts.

We invited the leadership team, which includes all the central office administrators (i.e., superintendent, director, supervisor, and coordinator, etc.) and school site principals to participate in this longitudinal study over three time points. Our data includes an average of 56 educational administrators across the district, reflecting an average response rate of 93%. Of the sample, an average of 48% worked at the district office and 52% worked as a principal at one of the district's school sites and an average of 60% was female. On average, these administrators had been an educator for about 21 years (SD = 8.8), working as an administrator for about eight years (SD = 5.7), working in the district for approximate 12 years (SD = 10.0), and in their current position for about three years (SD = 3.5). Sample demographics are presented in Table 1.

Table 1: Sample Demographics of Educational Leaders

	T1	T2	T3	Average
Number of leaders	51	52	66	56
Work level				
District	45%	44%	56%	48%
Site	55%	56%	44%	52%
Gender				
Female	63%	60%	56%	60%
Male	37%	40%	44%	40%
Experience				
Years of being an educator	19.8 (9.5)	20.5 (9.1)	21.9 (7.9)	20.73 (8.9)
Years in administration	8.2 (5.7)	8.1 (5.6)	8.6 (5.9)	8.3 (5.7)
Years at district	12.3 (10.0)	12.4 (10.0)	12.6 (10.2)	12.5 (10.0)
Years at current position	2.9 (3.1)	2.9 (3.1)	3.7 (4.2)	3.2 (3.5)

Note: Years of experiences are the number of years and standard deviation in parentheses.

3.2. Data Collection

Data were collected at three time points over one year and included the leaders' demographic information, various social aspects related to their work, and self-reported perceptions of the district's organizational learning climate. The span of data collection period covered the time prior to and during the adoption of new standards as we are interested in the district's alignment effort in its governance between its goal of collaboration and reform initiative.

Innovation network. We developed a series of social network questions that would assess different aspects of interpersonal relations based on earlier work (Daly et al., 2013). In this study, we particularly focus on innovation network relation as individual actors' tendency to interact with others for innovative ideas may be important in understanding the climate of organizational learning at reform. We invited all district and site leaders to assess the scale of interaction of other leaders by answering the prompt: "How likely is this administrator willing to take a risk on innovative ideas?" (referred to as innovation network), on a four-point Likert-type scale (1 = not very likely to 4 = very likely). For ease of response, we provided a roster with the names of the district and site leaders. Respondents could indicate with whom they are likely to nominate as the person who is willing to risk on innovative ideas by selecting any of the names of their fellow administrators and assessing corresponding scale of interaction with each nominee. The number of nominations that respondents could make was unlimited. Such free-choice and bounded approach is appropriate as the current study is focused on the

patterns of interaction within a finite network (Scott, 2000). We used the interaction scales of 3 and 4 (i.e., likely and very likely) among these leaders to indicate the "high propensity" of sharing innovative ideas as it may provide us with meaningful interpretation in understanding the improvement efforts.

Organizational learning (OL). The OL scale was drawn on a previously validated instrument called the Learning Organizational Survey (see Garvin, Edmondson & Gino, 2008) and further modified to fit the study sample and context. We conducted reliability test for internal consistency of each factor. The first component - formal mechanism for instructional practice (OL-IP) - includes five items with Cronbach's alpha ranging between .76 and .79. The second component - informal opportunities for PD (OL-PD) - consists of three items Cronbach's alpha ranging between .79 and .84. Table 2 presents the factor loadings for each subscale of OL at each time point.

3.3. Data Analysis

As we are interested in understanding the network pattern of leaders around innovative behaviors and their perceptions of OL over the study period, we use social network analysis to describe the network properties and descriptive and comparative analyses to indicate the difference between time points.

Social network analysis. We use the Netdraw software (Borgatti, 2002) to generate network sociograms to provide initial visualization of the network structure. We then use the UCINET 6.0 software package (Borgatti, Everett & Freeman 2002)

Table 2: Items, Factor Loadings, and Reliability (Cronbach's Alpha) of OL at Three Time Points

Item	Factor loading and reliability		
	T1	T2	T3
OL - formal mechanism for instructional practice	$\alpha = .76$	$\alpha = .79$	$\alpha = .76$
1. District administrators serve as a resource for one another	.87	.85	.80
2. District experiments with new ways of thinking	.84	.79	.76
3. District has a formal process for evaluating programs or practices	.69	.68	.74
4. District frequently examines instructional practices	.59	.68	.67
5. District frequently discusses the theory behind instructional practice	.50	.66	.65
OL - informal opportunities for PD	$\alpha = .81$	$\alpha = .79$	$\alpha = .84$
6. District values authentic professional development	.89	.86	.90
7. In District time is made available for education/training activities for school staff	.84	.86	.90
8. District provides dedicated time and space for sharing information among staff	.82	.80	.82

to calculate a series of network measures at both actor and whole network levels. The whole network level indices characterize innovation network while interpreting the sociograms. The actor level network analysis is to quantify individual leaders' connectedness in the innovation network that will be further used for interpreting the sociograms and conducting descriptive and comparative analyses.

Several indices are used to assess whole network properties. Network *density* indicates the percentage of ties that are present over all possible ties in a given network (Wasserman & Faust, 1994). Network *reciprocity* refers to the proportion of mutual ties over all possible mutual ties (Wasserman & Faust, 1994). The network *fragmentation* indicates the percentage of the number of disconnected dyads between two actors to all possible number of connected dyads in a network (Wasserman & Faust, 1994). The *E-I index* (External versus Internal) measures the degree of closure at the network, sub-network, and individual levels. The E-I index takes the number of ties that are external to the groups minus the number of ties internal to the groups, and divided by the total number of ties (Krackhardt & Stern, 1988). The index ranges from 1 (all ties are external) to -1 (all ties are internal). An E-I index near 0 indicates that the group has a balance of external versus internal interactions (Krackhardt & Stern, 1988). As the E-I index is sensitive to group size, we use the re-scaled E-I index to indicate the degree of closure at the whole network level.

We calculate outdegree, indegree, ego-reciprocity, and actor E-I index to measure the degree of individual leaders' connectedness. The actor *outdegree* refers to the number of outgoing ties an actor has, and in this case, the number of risk taking colleagues a leaders nominated and can be interpreted as an indication of the leader's "activity." The actor *indegree* is the number of incoming ties the actor receives from others, which indicates the number of risk taking nominations a leader received from colleagues and thus can be regarded as an indication of a leader's degree of popularity in taking risks of innovative behavior. The *ego-reciprocity* is the proportion of mutual ties an actor has over all possible ties that actor can have. The actor E-I index indicates the propensity of individual actors' connections toward in-group ties, out-group ties, or mutual.

Descriptive and comparative statistics. We calculated descriptive statistics for the study scale of OL and social network measures. We also conducted analysis of variance (ANOVA) for the actor level network measures and OL subscales to provide comparisons between time points.

3.4. Study Limitations

As with other empirical works, there are also limitations in this study, allowing the researchers to provide suggestions for future work. First, the study sample is confined to the districtwide leadership team that was present at each time point of data collection. However, this approach to understanding the team's development or improvement effort may limit the opportunity of tracking the over-time network change as a result of potential turnover. In other words, the current study is designed to compare the overall difference in network connectedness of the leadership team across time points with little attention to tracking the nuanced change in individual actors' position and its degree connectedness. As actors' network position and connection are consequential for one's capacity to access relational resources, exploring the tie change may yield detailed information about the change effort of individuals, which can be useful for making improvement planning at the district level. Future work may consider investigating the nuanced change in individual actors' ties regarding the quantity in the amount of exchange for innovative ideas as well as the quality of such exchange. Second, as we only examine the positive relationship a leader has with others regarding high propensity in risk taking activities, we acknowledge the consequential influence of negative relationships on organizational change (Daly, Moolenaar & Liou, Tuytens & Del Fresno, 2015; Uzzi & Dunlap, 2012). For instance, in our case, we could examine the relational pattern of leaders who nominate others as someone who are *less* likely to take risk in innovative ideas and further monitor the change of such risk-averse behaviors. This could be an important indicator assessing the level of organizational change. Finally, as the phenomenon of network churn (Daly, Finnigan & Liou, 2014, 2016; Sasovova, Mehra, Borgatti & Schippers, 2010) is typical in a given school district, in a longitudinal study it would also yield valuable input into our knowledge base to study the impact of churn on the performance of a leadership team in terms of collaboration around improvement. Future studies may explore the churn of educational leaders and its association with the change in district governance.

4. Results

4.1. High Propensity to Engage in Risk Taking Activities

Whole network level. Table 3 presents network measures of the innovation network at three time points showing the leaders' high propensity as a

risk taker on innovative ideas. The results indicate that on average about 32% of the ties that are present in the innovation network are high propensity for risk taking (average network density = .32). This network density increased from T1 (density = .29) to T3 (density = .32) with increased number of existing ties from 738 to 1.390. Less than 10% of the dyads between actors are disconnected, and that is, more than 90% of the pairs of leaders are highly prone to engaging in risk taking activities. Addi-

tionally, on average approximately 32% of the ties are mutual with an increase from T1 (reciprocity = .29) to T3 (reciprocity = .34). That is, about a third of the ties between leaders are reciprocated in nominating each other as a risk taker in innovative ideas. Moreover, a leader is on average connected to or from approximately 18 other leaders for high propensity for risk taking activities and such connection also increased from T1 (average in/out-degree = 14.47) to T3 (average in/out-degree = 21.06).

Table 3: Innovation Network Properties Over Time: Whole and Group Network Properties of High Propensity In Risk Taking Activities

Network measure	Time point			Average
	T1	T2	T3	
Whole network properties				
Density	.29	.33	.32	.32
Number of ties	738	887	1390	1005
Fragmentation	.08	.15	.08	.10
Reciprocity	.29	.33	.34	.32
Average in/out-degree	14.47	17.06	21.06	17.53
E-I index	.06*	.01	.01	.02
Group network properties				
Density				
District leaders	.36	.42	.28	.35
Site leaders	.23	.29	.38	.30
Number of ties				
District leaders	181	211	378	257
Site leaders	171	232	312	238
Fragmentation				
District leaders	.13	.17	.13	.15
Site leaders	.17	.14	.07	.13
Reciprocity				
District leaders	.34	.38	.35	.36
Site leaders	.27	.33	.34	.31
Average in/out-degree				
District leaders	7.87	9.17	10.22	9.09
Site leaders	6.11	8.00	10.76	8.29
E-I index				
District leaders (external/internal ties)	.06 (303/270)	.05 (338/306)	-.03 (524/558)	.01 (388/378)
Site leaders (external/internal ties)	.06 (303/270)	-.02 (338/350)	.06 (524/466)	.04 (388/362)

Note: The network measures are calculated based on the high propensity in taking risk activities in innovation network. * $p < .05$.

As for the degree of closure on work level, on average and across time points, the innovation network indicates a tendency of slightly external oriented with E-I index ranging between .01 and .06, suggesting that overall district and school leaders tend to engage in risk taking activities with each other regardless of their work level.

Group network level. In terms of the group network properties and cross-group interaction for both district and site leaders in regard to high propensity for engaging in innovative activities, on average, the district leaders have more connections with other leaders who also work at the district level than the site leaders in terms of density, number of ties, and average incoming and outgoing ties. The district leaders, compared to the site leaders, have more mutual ties with their district colleagues. Although the district leaders connect with many more others, which also tend to be mutual, the district leaders also have slightly more disconnected pairs in their group network.

Over time, the site leaders demonstrate an increase in group network density, number of ties, reciprocity, and average number of incoming and outgoing ties. Specifically, the site leaders engage in 83% more connections with other site leaders (number of ties increasing from 171 to 312), resulting in a 70% increase in site leader network density from T1 (.23) to T3 (.38). Individual site leaders are connected to or from 76% more other site leaders. The site leaders' in-group mutual ties also increase at 30%, reflecting a 60% decrease in group network fragmentation from T1 (.17) to T3 (.07). As for the district leader network, over time the district leaders demonstrate increase in only the number of total ties and average incoming and outgoing connections. However, the increase is at a lower

rate such that the density and reciprocity drop at T3 is due in part to the larger group network size at T3. This suggests room for the leadership team to develop more connections at the district level regarding risk taking as the team size on the part of district increases 61% since T1. In sum, the district leaders demonstrate an overall increase in risk taking activities from T1 to T3 with variations in over time change between T1 and T2 and between T2 and T3.

In terms of cross-group interaction, over time the interactions between district and site leaders indicate a propensity of ties to be slightly outwardly connected, but the difference is not significant. This corresponds to the whole network finding that the leaders are likely to engage in risk taking activities with leaders who are at the same or different work levels (district/site).

Actor level. Since the pattern of in- and out-group interactions in this innovation network between district and site leaders appear to be similar, we further examine the actor level connectedness across time points regardless of the work level difference. The actor level network properties allows us to explore whether or not there is a difference in actor network properties between time points as a way to understand the over time change in the leadership team's relational effort around innovation. Table 4 presents the network properties of individual leaders at each time point and the comparisons between time points. The results indicate that individual leaders are more likely to reach out to approximately 18 other leaders for innovative ideas (avg. outdegree = 17.84, SD = 13.02) and also are more likely to be nominated by 18 other leaders as a risk taker (avg. indegree = 17.84, SD = 10.60). Across time points, we found that such risk taking activities increase significantly from T1 to T3, mean-

Table 4: Innovation Network Properties Over Time: Actor Network Properties of High Propensity to Engage In Risk Taking Activities

Actor level network properties	Time point			Average	F	df	p
	T1	T2	T3				
Outdegree	14.47 (11.21)	17.06 (12.18)	21.06 (14.33)	17.84 (13.02)	3.95	2	.021 ²
Indegree	14.47 (7.71)	17.06 (9.11)	21.06 (12.63)	17.84 (10.60)	6.12	2	.003 ^{2, 3}
Reciprocity	.25 (0.16)	.28 (0.19)	.29 (0.17)	.27 (0.17)	0.82	2	.441
External ties (out-group)	11.88 (6.21)	13.00 (6.71)	15.88 (8.52)	13.79 (7.50)	4.70	2	.010 ^{2, 3}
Internal ties (in-group)	10.59 (5.1)	12.62 (5.38)	15.52 (7.29)	13.14 (6.42)	9.62	2	.000 ^{2, 3}
Actor E-I index	.04 (0.29)	-.02 (0.23)	.01 (0.25)	.02 (0.26)	0.65	2	.524

Note: Actors all leadership team members. Values provided in each time point represent mean and standard deviation in parenthesis. *p*-value superscript notation: 1 = significance between T1 and T2; 2 = significance between T1 and T3; 3 = significance between T2 and T3.

ing that leaders are increasingly demonstrating high propensity to engaging with others in risk taking activities between T1 and T3.

In terms of reciprocity, approximately 27% of individual leaders' ties are mutually connected with others. However, while there is an increase in reciprocity over time no significant difference was found between time points. Regarding individual leaders' tendency of out-group and in-group connectedness, the results indicate significant increases in the number of leaders' out-group and in-group ties over time. As leaders are connecting with more other leaders from same or different work levels over time, the balance between out- and in-group ties remains similar, and as such there is no significant difference in actor level E-I index between time points. This corresponds to the whole and group network findings that leaders demonstrate a consistent pattern in connecting with similar amount of other leaders from same or different work levels over time.

4.2. Organizational Learning

Table 5 presents the perceived OL of leadership team at each time point. There is no statistically significant difference in both subscales of OL between district and site leaders at each time point, suggesting that the perception of OL is consistently similar between district and site leaders across time points. As such, we examine the overall trend of perceived OL among all leaders. First off, the overall leadership team perceives higher levels of the two subscales of OL across time points. That is, they perceive there are certain types of formal and informal structures provided for them to improve instructional leadership practice. When looking at the difference between time points, their perceptions of OL-IP and OL-PD increase significantly

between T1 and T3, although a slight drop at T2. It is noteworthy that such perceived overall OL increases from the spectrum of "somewhat agree" to a firm "agree" over time, suggesting the district's improvement effort is manifest to the leadership team. Furthermore, while it seems that the leadership team's overall perceptions on OL-IP and OL-PD fall in between "somewhat agree" and "agree" range, the percentage of those who perceive "agree" and "strongly agree" increases significantly between T1 and T3. Approximately two times of leadership team members perceive higher levels of OL at T3 (OL-IP. $\Delta_{\text{Agree}} = 65\%$; OL-PD. $\Delta_{\text{Agree}} = 67\%$) than T1 (OL-IP. $\Delta_{\text{Agree}} = 35\%$; OL-PD. $\Delta_{\text{Agree}} = 35\%$).

4.3. Mapping Innovation Network and Organizational Learning

Along with significantly increased perceptions of OL as well as a number of significant increases in network properties, we further present our findings using another social network technique - Net-Draw (Borgatti, 2002) - as a way of triangulating the findings through visualization using sociograms. In Table 6, we present a set of sociograms of the innovation network that measures the high propensity for risk taking activities. In these sociograms, we incorporate the network properties and leaders' perceptions of OL on the part of mechanism for instructional practice (OL-IP) as a representative case to make sense of the interplay between leaders' perceptions of OL-IP and their innovation network connectedness. Nodes in these sociograms are individual leaders, and lines represent the flow of risk taking nominations with arrowed head indicating the direction of nomination. The nodes are also colored by work level: leaders with red nodes work at the district level and blue nodes

Table 5: Perceived Organizational Learning over Time

	Time point			Average	F	df	p
	T1	T2	T3				
OL - Mechanism for instructional practice							
Overall mean (SD)	4.13(0.80)	3.93(0.78)	4.55(0.65)	4.23(0.78)	11.19	2	.000 ^{2, 3}
% of reported "Agree"	35.3%	25.0%	65.2%	41.8%	11.90	2	.000 ^{1, 2, 3}
OL - Opportunities for PD							
Overall mean (SD)	4.11(0.98)	4.03(0.82)	4.60(0.68)	4.28(0.86)	8.51	2	.000 ^{2, 3}

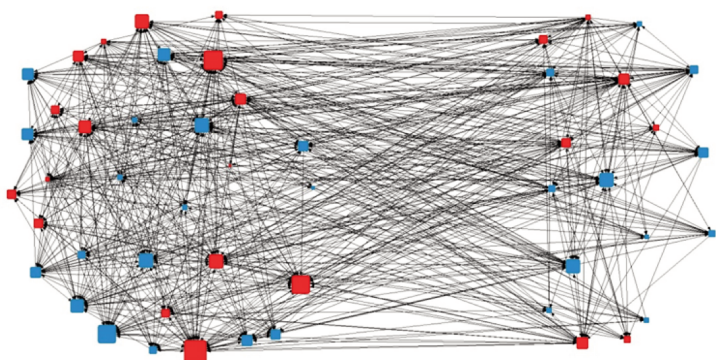
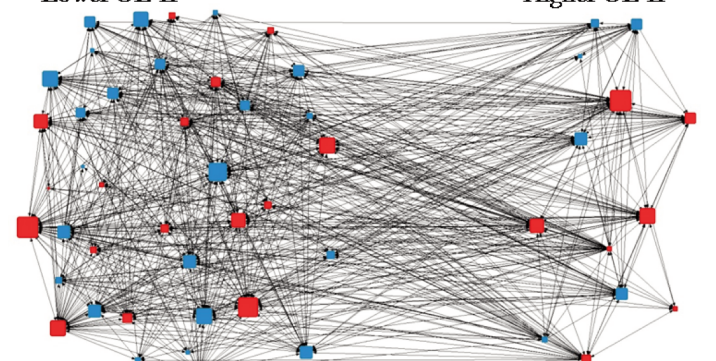
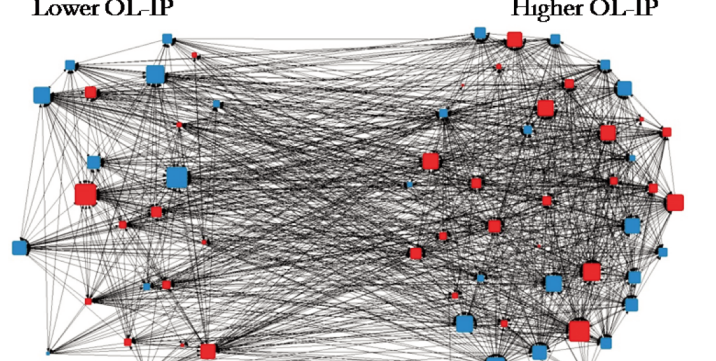
Note: Values provided in each time point represent mean and standard deviation in parenthesis except the values in percentage. OL instrument is based on a six-point Liker-type scale: 1 (strongly disagree), 2 (disagree), 3 (somewhat disagree), 4 (somewhat agree), 5 (agree), and 6 (strongly agree). p-value superscript notation: 1 = significance between T1 and T2; 2 = significance between T1 and T3; 3 = significance between T2 and T3.

at school sites. The nodes are sized by actor in-degree: the larger the node the more nominations that leader received from others as a risk taker. Finally, the nodes are grouped by level of perceived OL-IP with higher levels on the right and lower levels on the left of the sociogram.

The results from these sociograms indicate that corresponding to the trajectories found in our network properties, over time the innovation networks are more densely connected with greater number of overall ties and average actor's degree centrality. In addition, the number of leaders with higher

levels of perceived OL-IP (actors on the right hand side of the sociograms) increases from 35% to 65%, meaning that a significantly increased number of leaders perceive higher levels of the district's climate of OL-IP over time. Finally, also confirming our cross-group network properties, the sociograms indicate a consistent and coherent network structure across time points with the same number of community¹ found at each time point. This means that there is no significant cross-group interaction among leaders, reflecting that both district and site leaders share a similar amount of in-group and out-group

Table 6: Innovation Network Sociograms of High Propensity in Risk Taking Activities among Leaders

Time point	Innovation network sociogram	Network properties
T1	<p style="text-align: center;">Lower OL-IP Higher OL-IP</p> 	<p>Network size = 51 Number of ties = 738 Actor in/out-degree = 14.5 % of higher OL-IP = 35.3% Number of community = 1</p>
T2	<p style="text-align: center;">Lower OL-IP Higher OL-IP</p> 	<p>Network size = 52 Number of ties = 887 Actor in/out-degree = 17.1 % of higher OL-IP = 25.0% Number of community = 1</p>
T3	<p style="text-align: center;">Lower OL-IP Higher OL-IP</p> 	<p>Network size = 66 Number of ties = 1390 Actor in/out-degree = 21.1 % of higher OL-IP = 65.2% Number of community = 1</p>

ties and as such none of the groups demonstrates a propensity that is significantly inwardly or outwardly concentrated. The pattern of risk taking relationships among all leadership team members yields single community with a balance between in-group and out-group connections.

5. Discussion and Conclusion

This paper focuses on the role of a districtwide leadership team in governing the district's improvement efforts around the new standards from a longitudinal study using a social network approach. We foreground the important social and relational aspect in district governance in support of reform. Specifically we examine the leaders' efforts around innovation and OL over time as a way to understand its change process. Examining innovation in terms of social relations not only attends to the recent call for a more innovative and collaborative approach to leadership and learning (OECD, 2013), but also address current reform concern about the lack of innovative strategies in instructional design and practices (Polikoff et al., 2014). Our work indicates several increased trajectories in leaders' risk taking behaviors and perceived OL over time and a balanced in- and out-group interaction for risk taking activities. That is, the leaders have connected with more other leaders for engaging in risk taking activities, regardless of their work level over time. This increased connectedness in innovation network is coupled with the increase in leaders' perception of districtwide learning climate, suggesting a cohesive improvement phenomenon in the behaviors and perception of leadership team. The study findings may be transferable to other school districts that also operate under the governance of leadership teams.

While a number of prior studies pointed out a need for district-school relationship at reform (Daly, Liou, Tran, Cornelissen & Park, 2014; Daly & Finnigan, 2011, 2012; Finnigan, Daly & Che, 2013), the present study offers a promising case example of bridging the linkage between district and school leaders in networked governance and distributed leadership around reform. Our case exemplifies a community of practice at the district level as the team's innovative leadership practice stretched across members from different work levels. While the degree of connectedness across the team decreases in the second time point, the degree of collaboration bounces back and goes significantly above and beyond the baseline benchmark at the third time point.

This change in connectedness in the innovation network may be due in part to the preparation for the new standards. A year before the district implemented the new standards, the district had un-

dergone a series of preparation and planning including gathering more resources and making sure they had the right crew on board ready for the implementation. However, implementing the new standards requires the exploration of new ideas/knowledge which may not be able to obtain from the pre-existing ties given the newness of the standards. Therefore, seeking new ties from others may better supplement the lack of innovation indicated in the existing ties. This phenomenon can be explained in our data between T1 and T2 and between T2 and T3. The number of leadership team members at T1 and T2 is similar with only one or two cases of turnover, and as such the connections among leaders between T1 and T2 made up the existing ties (existing social capital) as the leaders were basically seeking innovative ideas with the same group of leaders. However, as the district re-arranged the composition of the team at T3 by adding about 30% newcomers, the average degree of connections per leader increased significantly by approximately 45% between T1 and T3 and another significant increase in the proportion of risk takers between T1 and T3 and between T2 and T3.

This suggests that having the opportunities to connect with new members may help individual leaders develop new social capital assets in meeting the needs for innovation, as suggested in previous studies (Baker, 2014). For leaders to better govern an organization, with limited fiscal resources available for many school districts to recruit newcomers, one course of actions may be to extend the range of expertise to school leadership teams that may potential bring in innovative strategies and serve as alternative hubs at the site level (e.g., Johnson & Chrispeels, 2010). Such an approach requires a better communication channel between the district and school site leadership team with the role of site principals being a communication broker (Carpenter, Esterling & Lazer, 2004) that potentially builds open, two-way communication (Neves & Eisenberger, 2012).

The study of a districtwide leadership team is unique but the role of the leadership team is not uncommon in most of the school districts in the USA. As such, rather than outsourcing partnership relationships with external partners for improvement, this work suggests a cost-effective approach to reform is to maximize existing human capital through social capital (Smylie & Hart, 1999). The case study results are promising as it demonstrates the success in district's alignment effort between its goal and action at the leadership level. Network studies suggest that the collaboration effect on the managerial and leadership levels may very likely spread across to groups of employees in terms of norm of collegial interaction (Brass, Galaskiewicz, Greve & Wenpin, 2004). For districts aiming at

building cross-unit/level collaboration for improvement, it is important to create conditions that are risk tolerant, supportive in opportunities for collaboration, and oriented toward learning. In the

long term, we may expect a potential influence of the team's collaboration on the pattern of teacher-leader and/or teacher-teacher collaborative interactions at the school level.

Notas

¹ The index of community or faction measures the degree to which a partition consists of cliques like substructure within a given network (de Amorim, Barthélemy & Ribeiro, 1990).

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AUTHOR'S ADDRESS

Yi-Hwa Liou. Department of Educational Management. National Taipei University of Education. No. 134, Sec. 2, Heping E. Rd, Taipei 10671. Taiwan.
E-mail: yihwa.liou@gmail.com, yhliou@tea.ntue.edu.tw

Alan J. Daly. University of California, San Diego . 9500 Gilman Drive. La Jolla CA USA 92037.
E-mail: ajdaly@ucsd.edu

ACADEMIC PROFILE

Yi-Hwa Liou. Assistant Professor. National Taipei University of Education.

Alan J. Daly. Graduated from Clark University with a BA in Psychology, received a MS in Counseling from San Diego State University, and a MA and Ph.D. in Education with an emphasis in Educational Leadership and Organizations from the University of California, Santa Barbara.

