Exploring Teacher’s Professional Learning Communities:

From Individual Resourcefulness to Organizational Learning

Warangkana Lin
The University of Hong Kong
annavision0907@gmail.com

Prof. Moosung Lee
The University of Canberra
MooSung.Lee@canberra.edu.au

Abstract

This study addresses a concept that has been less examined in empirical research on school organization, namely individual resourcefulness, referring to Flap’s (2002) measurement of individual’s capacity of being resourceful. We assumed that individual school staff’s network properties influence the formation of individual resourcefulness which in turn shapes the organizational learning mediating through professional community practices. To this end, social network analysis was first conducted to explore the professional networks and network properties. Next, confirmatory factor analysis was applied to validate the constructs of professional community and organizational learning. Finally, structural equation modeling was used to identify relationships among network properties, individual resourcefulness, professional community practices, and organizational learning. The result from our case study suggested that certain network properties are crucial for forming individual resourcefulness on instruction and reflective dialogue is the key component in establishing organizational learning. Implications for how professional community and organizational learning can be promoted in schools with a focus of individual resourcefulness will be discussed.
Introduction

In this study, we aim to test an overlooked concept in the studies of school organization in general and organizational learning in particular—i.e., individual resourcefulness.\(^1\) In educational research, studies exploring individual resourcefulness are very scarce. In a study conducted by Castro and his colleagues, the term resourcefulness was used as one of the personal factors for novice teachers to be resilient when encountering adversities as a process of adaptation (Castro, Kelly, Shih, 2010, p.623). Specifically, this study investigated the strategies of resilience that fifteen novice teachers employed in high-needs areas such as in urban and rural contexts. The study indicated that these beginning teachers utilized varieties of strategies, including help-seeking, problem-solving, managing difficult relationships, and seeking rejuvenation in order to build additional resources and support. Another study conducted by Richardson et al. (1990) found that when teachers become resourceful, they negotiate and overcome challenges in the normal process of their work life (Richardson, Neiger, Jensen, & Kumper, 1990). Oftentimes, these resourceful teachers relied on an extensive network of support involving teacher colleagues and friends (Standford, 2001). Another study exploring the concept of resourcefulness was conducted in Zambia. The study interviewed grade one to nine Zambian teachers to explore the characteristics that are believed to be essential for teachers to possess in order to be an expert teacher. The study

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\(^1\) The term has been mainly used in political science. For example, MacKinnon & Derickson (2013,p.263) proposed the term “resourcefulness” as an alternative to the word “resilience” in relevance to material inequality and issues of resource maldistribution. Resourcefulness emphasizes forms of learning and mobilization based upon local priorities and needs as identified and developed by community activists and residents. This conception of resourcefulness leads to a democratic self-determination as a foundation of society. In contrast to the negative connotation of resilience, resourcefulness positively accommodates both local issues and appreciates systematic challenges.
suggested that resourcefulness and creativity are a vital characteristic for an expert teacher in Zambia given the dearth of quality teaching and learning materials and a continued lack of funding for schools (Thomas & Thomas, 2011, p.591). The term “resourcefulness” in this study was conceptualized as teacher’s ability to plan, think, and use their initiatives to support their lessons when resources are scarce.

In our study, we investigated teachers’ network behaviors during school reform and how the professional behaviors affect the learning level in the school. Consistent with the findings of Castro et al. (2010) and Stanford (2001), we assumed that resourcefulness reflects the level of one’s expertise in conjunction with one’s accessibility to colleagues. This assumption was drawn from our initial interviews with 11 teachers in the case school. Teachers were asked to describe the quality of the persons that they would turn to in order to support their professional growth during school reform. Teachers described two major factors. First, they look for a person who possesses knowledge and expertise. Second, they look for a person who has positive attitudes and willingness to share. From the interviews, these two qualities complement each other in the way that describes teachers’ professional strengths and capacity.

Following the initial finding noted above, we planned to investigate the relatively less charted concept of resourcefulness in connection with teacher learning. We assumed that the degree of “resourcefulness” as a form of individual capacity in conjunction with an outcome of their continuous learning varies by teachers. In other words, teachers’ being resourceful refers to a certain status of each individual teacher’s capacity for learning activities. We hypothesized that such resourcefulness may affect the way they learn, interact, and collaborate with peers. Given that it is a still novel concept in educational research, we also operationalized the concept as comprising one’s expertise on instruction and one’s ability to establish effective social links in school. This mirrors the situation that teachers who have
experience and expertise, and are able to position themselves critically in the school network, tend to be those who possess high degree of individual resourcefulness.

Further, we aimed to link individual resourcefulness to organizational learning in our investigation. Teachers learn through generating locally relevant knowledge of practice by working within the context of inquiry communities (Cochran-Smith & Lytle, 1999, p. 272). Thus, the boundary of teacher learning was classified into two layers: Individual learning and organizational learning (McCormick et al., 2011, p.163). The latter type of learning is defined as “the collective ability of people in an organization to learn their way out of trouble” (Hargreaves, 2007, p. 185). This study was premised around the assumption that when teachers learn collaboratively, they develop their own individual resourcefulness; and subsequently an accumulation of this individual resourcefulness in the school leads to the elevation of organizational-level learning. Put differently, the development of this teacher learning process, therefore, results in organizational learning embedded in the school. In sum, the primary purpose of this study is to explore such linkage (i.e., development of individual resourcefulness to organizational learning) empirically.

**Professional Networks and Professional Learning Communities**

Research in these recent years suggests that collegial relationship promotes teacher’s professionalism to their success, satisfaction with students and career, engagement and commitment to the career of teaching (Little, 1990, 2002, 2003; Louis, Marks & Kruse, 1996, Pounder, 1999). Therefore, it comes to our attention that creating and supporting professional relationships and networks is a critical way to sustain and improve the work of teaching and learning in schools (Daly, 2010, p. 1). Various efforts have been made to understand how classroom teaching practice are shared, developed, and known among teachers through their out-of-classroom interactions, however, there was not sufficient evidence of the studies that explore teacher’s behavior and interactions with network analytical approaches. Little (2003,
p.917) indicated that there is a need for a fine grained analysis to examine these specific interactions and dynamics by which professional communities constitute a resource for teacher learning and thus the formation of teaching practice. Similarly, McCormick et al. (2011, p. 42) pointed out the insufficiency of current research in teacher network and professional learning communities in relation to teacher and school learning. Indeed, few studies have investigated the nature of learning process from a network analysis perspective although the conceptions of professional learning communities (PLCs) and network are interdependent; the word ‘community’ itself involves strong links of members that are required for collaborative activities that are at heart of community (McCormick et al., 2011, p.9). Veugelers and O'Hair (2005, p. ix) integrated the concepts of PLC and network as described below:

The same principles apply to professional learning communities in themselves – they grow stronger and become more vibrant when they are connected to other learning communities, rather than when they operate entirely alone. The best way to bring this about is through networks.

Of researchers who started to identify the possibility, need or value of network approaches to PLCs, it is worth mentioning Little’s point (2005, pp. 277-279) that ‘networks’ actually span their arrangements in various forms: networks of schools, networks of specific professional development programs, networks of teachers who share common interest. Little (2005, p.277) explained

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2 Although we focus on school-based professional networks, due to the scope of data collection in this study, we wish to note that there are studies highlighting importance of outside school linkages of professional networks. For example, Jackson and Temperly (2007, p. 47) suggested the importance of networked learning as it is at heart of the relationship between school networks and the professional learning community. The emphasis was put on between-school professional networks rather than the network within one school.
At its best, the research helps to identify conditions conducive to professional learning in various kinds of networks and to suggest network effect on school-level improvements. However, the available research also reveals substantial variation in the ability of networks to influence teacher practice or build schools’ organizational capacity for improvement. Further, there is relatively little research that takes up the broader question of how networks enhance the production and/or flow of useful knowledge. Nor is there much research that delves deeply into the nature of network activity and into the question of precisely how such activity achieves its effect on thinking and practice beyond the network itself.

Specifically, Little (2005, pp. 278-279) suggested that researchers need to investigate how school and network environments supply resources for professional learning and consequently for school improvement. Similarly, McCormick et al. (2011, p. 57) posited his view of ‘community’ in relation to teacher learning: “We have already noted the argument deriving from SNA that ‘community’ has changed and that using networks as an analytic concept is a more productive way of thinking about community.”

While various efforts have been made to investigate professional learning communities (PLCs), many researchers have pinpointed that the importance of examining teacher’s communities should be conducted beyond identifying characteristics of PLCs, but rather investigating the process of PLCs formation and the factors that affect their development. In recent decades, the study of teacher professional networks has grown alongside the modified perception of teacher learning from individual to collective notion. Examples include a) Lieberman and Wood’s (2002) study on role of teachers in relation to networks and professional communities, b) Stoll et al.’s (2006) review of PLCs, c) Jackson and Temperly (2006)’s study of network learning, and d) Veugelers and O'Hair's (2005) investigation on
how networks enhance collaboration in PLCs. These studies have revealed a substantial influence of informal networks on teacher practices. For example, Lieberman and Wood (2002, pp. 331-333) described various advantages of teacher networks in relation to how they brings about powerful learning experiences in practice. Some major ones include (a) networking teachers have numerous opportunities to recognize, articulate, and share their own tacit knowledge with each other, (b) networks tend to foster problem posing and questioning over prescriptive and pre-packaged answers, (c) networks provide multiple opportunities for members to learn and take leadership roles, and (d) networks promote collaboration among members.

It is obvious that both professional learning communities and teacher networks are built around the idea of collaboration (McCormick et al., 2011, p. 228). However, McCormick (2010, p. 404) raised the confusion of usages of the two that appeared in previous research. He stated that some researchers confused the idea of a network when describing about community and did not apply it in an analytical way. Reflecting this, in this study we focus particularly on the mechanism of how the professional learning community is shaped through teachers’ professional networks in the case school. Specifically, we dissect the concept of professional learning communities (PLCs) into two sub-constructs as professional community and organizational learning; where we view professional community as an influence on organizational learning.³ To be consistent to the context of social network analysis, in which the emphasis is on professional interactions and behavior, we confine professional community constructs in behavioral domain that includes reflective dialogue and deprivatized practice (Bryk et al., 1999); these two domains are detailed in the following

³ We admit that the relationship between professional community and organizational learning would be mutual eventually. However, given the nature of this study as a cross-sectional analysis, in theory, we assume that professional community is an antecedent factor that influences organizational learning.
section. Then, we look at how teachers’ professional networks are associated with those PLC constructs through individual resourcefulness.

**Professional Communities and Organizational Learning**

There is an understanding, built upon evidence, that the enhancement of teacher learning through collaboration in PLCs leads to improved student learning (McCormick et al., 2011, p. 9). In addition, developing professional learning communities tends to be a promising way to build school’s capacity for sustainable improvement over time (Stoll et al., 2006, p. 221). Although the definition of PLCs varies depending on the context of study, they tend to share the commonality that PLCs involve a group of people actively sharing and critically examining their practice in an ongoing, reflective, collaborative, inclusive, learning-oriented, and growth-promoting way toward the problems and perplexities of teaching and learning in order to improve student outcomes (Mitchell, 2011, p. 12; Toole & Louis, 2002). In the school community context, Stoll et al. (2006, p. 223) conceptualized PLCs as the process “in which the teachers in a school and its administrators continuously seek and share learning, and act on their learning. The goal of their actions is to enhance their effectiveness as professionals for the students’ benefit; thus, this arrangement may also be termed communities of continuous inquiry and improvement.”

Notably, PLC tends to be the term that is used in recent years as an integrated notion of professional communities and organizational learning. Louis, Kruse, and Bryk (1995) introduced five characteristics that enhance professional communities. Those are shared norms and values, collective focus on student learning, deprivatized practice, reflective dialogue, and collaboration (Louis, Marks, et al., 1996, pp. 760-761). Bryk et al. (1999) categorized the aforementioned characteristics into two major areas: normative and behavioral.
Shared norms and values, collective focus on student learning, and collective responsibility for improvement are considered to be normative factors. In professional learning communities, these shared beliefs of organizational purposes, practices, and expectations of students provide a normative structure that guides teacher professional behavior. Specifically, when sharing norms and values, teachers affirm, through language and action, their common beliefs and values underlying assumptions about students, teaching and learning, teachers’ roles and expectation of students. It is the naturally developed guidelines that are agreed upon among teachers, rather than externally imposed in a bureaucratic measure (Bryk et al., 1999, p. 754). The concept of collective focus on student learning was considered to be a vital characteristic of professional communities. This leads to a sense of mutual obligations among teachers rather than by rules (Leithwood & Louis, 1998, p. 280). Some researchers and practitioners are concerned that the reverse effect of collective focus on student learning may lead to the so-called academic press. Although research has shown evidence that a strong academic press is positively associated with student achievement (Hoy et al., 2002), some still question if this emphasis on student performance may lead to competition among teachers that would in turn be detrimental to the development of professional communities. It is conceivable that such a working norm may put peer pressure and accountability on teachers whose students do not meet the required standards. As a result, the phrase ‘collective focus on student learning’ was modified in the subsequent studies to collective responsibility for student learning (Stoll et al., 2006, p. 226) while some researchers use the term ‘shared responsibility’ that tends to broaden the teacher’s responsibility beyond student assessment outcomes.

Deprivatized practice falls into the behavioral domain of professional learning communities. As mentioned, in professional communities, there is an assumption that

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4 Here, academic press refers to the extent to which the school is driven by a quest for academic excellence (Hoy, Sweetland, & Smith, 2002, p. 79).
teachers work by taking turns in their roles as mentor, adviser, or specialist (Little, 1990). Through team teaching, peer coaching, classroom observation, inviting colleagues to classroom teaching, and seeking feedback, teachers share and learn from each other instructional practices. In addition, they learn each other strengths and therefore are able to seek advice from the right person. This leads to an improvement in both classroom practice and collegial relationship (Lee, Louis & Anderson, 2012; Louis, Marks, et al., 1996, pp. 760-761).

Reflective dialogue is another behavioral concept of professional community. Reflection promotes teacher’s awareness of their practice and its consequences (Louis, Kruse, et al., 1996; Leithwood & Louis, 1998, p. 281). Strong professional communities are built upon teachers who regularly engage in deep discussions with colleagues - reflective dialogue - about their teaching, learning, and instructional practice (Bryk et al., 1999, p. 754). Through engaging conversations about their work, teachers can deepen their understanding about the process of instruction and ideas created within the teaching and learning process (Lee, Louis & Anderson, 2012).

It is understood that professional communities foster the sharing of expertise, and teachers depend on each other to discuss the development of skills related to the implementation of practice (Little, 1990). Therefore, when there exists deprivatized practice and reflective dialogue in teacher’s community, there is also collaboration among them. In other words, collaboration is a natural outgrowth of reflective dialogue and deprivatized practice (Leithwood & Louis, 1998, p.281).

Organizational learning is perceived as a final end of promoting PLCs. In other words, when schools acquire, develop, and possess the knowledge and resources, schools will need certain mechanisms and a commitment to sustain and share the developed expertise. That being said, organizational learning refers to the construction of meaningful contexts and
conditions under which routines are properly shared and collectively practiced (Louis, 2006, p. 481). In short, organizational learning involves how teachers continuously and collectively act on acquired knowledge. Louis (1994) suggested organizational learning as a model for school reform in which people working within school organizations are part of the shared meaning common to all members. This change model is premised around the belief that learning takes place in groups and cannot be reduced to a random accumulation of individual knowledge and that learning occurs within a framework of systematic collection of, and focus on, information. While individual learning tends to be relevant to the notion of acquisition, storage, and retrieval of knowledge; organizational learning differs in that it requires that knowledge have a shared social construction common to all members of the school organization (Louis, 2006, p. 480). Through collaboration, teachers work together to gather information about their teaching and their content area. They then discuss, share, exchange and critique, which fosters the collective level of learning in school organization.

**Research Hypotheses**

As discussed earlier, we view individual resourcefulness comprising *one’s expertise assessed by his or her colleagues and one’s ability to establish effective social links*. Therefore, one’s individual resourcefulness is critically influenced by one’s social relationships or networks. In other words, one’s individual resourcefulness is conditioned by a set of social structures he or she is placed in a school organization where he or she can navigate resources for learning and development. Consequently, we think that one’s network structure and position would play a key role in shaping individual resourcefulness. As such, we put individuals’ network properties as antecedent factors that influences the formation of individual resourcefulness in our analytical model. Further, we assume that individual resourcefulness would contribute to professional community related behaviors such as deprivatized practices and reflective dialogues which in turn influence organizational
learning. Specifically, these analytical relationships are presented in the following hypotheses:

- First, key network properties of individual teachers will have a direct effect on the formation of individual resourcefulness.
- Second, individual resourcefulness will have both direct and indirect effects on teachers’ professional community and organizational learning. The indirect effect of individual resourcefulness on organizational learning is assumed to be mediated through professional community (i.e., deprivatized practice and reflective dialogue).
- Third, teachers’ professional community will have a direct effect on organizational learning.

These hypotheses are presented in our conceptual framework (i.e., Figure 1) where the key analytical foci are (a) on the role of individual resourcefulness in mediating path between teacher’s network phenomena and the enactment of PLCs and (b) the relationships between professional community (i.e., reflective dialogue and deprivatized practice) and organizational learning.

Figure 1. Conceptual Framework
Methodology

Site Selection for Case Study

This case study, employing a sequential mixed-method approach: a) initial qualitative interviews, b) major quantitative analysis, and 3) supplementary qualitative interview analysis. This research design targeted a school that has undergone an extensive school improvement process, including the authorization process of three International Baccalaureate (IB) programmes from 2007 to 2012 and continuing with the Council of International Schools (CIS) accreditation with the scheduled accreditation visit in 2015. As collaboration is one of the major attitudes and beliefs around the central theme of becoming a successful IB teachers (Bergeron & Dean, 2013), the school’s improvement process related to IB authorization and CIS accreditation provided a backdrop for teacher collaboration where teacher learning is supposed to occur. This organizational context appeared to be an appropriate setting for our intention to explore how the capacity of teacher’s individual learning (i.e., individual resourcefulness) is transformed into organizational learning through professional communities during the school improvement process.

Data Collection

The data were collected from an international school adopting the IB in East Asia. Three types of data were collected. First, whole network data (i.e., school-based network) from 101 school staff members in the school were gathered through a network survey. The survey for network data collection was designed using the combination of social network survey design from Marsden (2011), the concept of depth and intensity of teachers’

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5 The mixed-method design was based on a quantitative first and qualitative follow-up approach (Teddlie & Tashakkori, 2003). The underlying purpose of this research design was to elaborate quantitative findings through follow-up qualitative analysis. In this regard, this study is a quantitative dominated, qualitative-less approach.
interactions (Little, 1990), social network dimensions in school from Coburn, Russell, Kaufman, and Stein (2012). The response rate of network data collection was 98% and the missing value from the gathered data was less than 1%.

Second, after gathering the network data, the follow-up survey aimed to measure the extent to which the school community embraced the characteristics of PLCs. The survey was designed using the combination of elements from the existing, validated survey instrument used by Louis, Leithwood, Wahlstrom, Anderson, & Michlin (2010). However, given this survey instrument was developed from western contexts, we collected another dataset for conducting both qualitative and quantitative Delphi studies, which aimed to contextualize the existing survey to the settings of our case school. As such, the original survey for measuring professional community and organizational learning was adjusted. Specifically, two subconstructs of professional community – i.e., reflective dialogue and deprivatized practice - were retained in the study, and the survey items related to shared responsibility were deleted since their content validity ratio did not meet the minimum required standard (Lawshe, 1975); see Appendix 1. The response rate of the follow-up survey was 98% and the missing value from the survey data was approximately 3%.

Finally, both at the beginning of the study and the end of the study, interviews with selected teachers were conducted. The initial interviews helped us to confirm research ideas and questions. The final interviews were conducted to supplement findings from the quantitative data noted above. Specifically, the major focus of the interview is relevant to how individual resourcefulness is mediated through professional community practices or is transformed to the organizational level of learning. In total, twenty two teachers in both primary and secondary sections were selected mainly based on the nature of their work, their position in the school network, and/or the network properties that the teachers possessed.

Measures
Network Measures. Following Freeman (1977, 1979) we used three distinctive network properties measuring central roles of actors in a network, known as degree, closeness and betweenness centrality. First, degree centrality captures the central role of one focal actor by simply measuring the degree of the actors who are adjacent to them. In a directed (or directional) network, 'indegree' centrality is the portion of actors who are adjacent ‘to’ each focal actor, and 'outdegree' centrality is the portion of actors that are adjacent ‘from’ each focal node. In this study we applied both 'outdegree' centrality and 'indegree' centrality. Conceptually, outdegree centrality is related to the degree to which an individual teacher (alter) actively seeks instructional advice/information from certain teachers (egos) in the network. In the context of network analysis, this can also be seen as the action teachers take to mobilize resources embedded in their professional relationships. On the other hand, indegree centrality refers to the degree to which an individual teacher (alter) is being sought or approached by their professional colleagues (egos). For example, we can say that some teachers would be actors with high outdegree centrality when they possess many choices of contacts, which in turn is viewed as their ability in seeking and mobilizing their resources to support their learning. Hence, the major focus of our analysis is with the outdegree value of network properties, although analysis also included an indegree centrality measure, given that some teachers with high indegree centrality would be teachers that many colleagues turn to for advice or information.

Second, closeness centrality is used as a crucial instrument because it reveals the degree to which one particular actor gets to other actors along the shortest path. Closeness centrality is calculated as the inverse of the sum of distances from an actor to all the other actors (Wasserman & Faust, 2007). Therefore, larger distances between the particular actor and others generate lower closeness centrality scores (Nooy, Mrvar, & Batagelj, 2005). Intuitively, we can speculate that certain influential teachers who have shorter paths
connecting to other teachers in the school professional network would be more likely to benefit from tapping into the resources embedded in the network. As the focus of this study is on how teacher’s network-oriented behaviour affects their individual resourcefulness, we used outdegree closeness centrality and disregarded indegree closeness centrality. We focused on outdegree closeness centrality because it conceptually captures the extent to which a particular alter is directly or indirectly connected to all other egos in the network when seeking instructional advice. Also, analytically, we were concerned about both parsimony model (given the relatively small sample size) and correlation—i.e., high correlations between indegree closeness centrality with other network properties.

Third, another distinctive idea of centrality, suggested by Freeman (1979) is betweenness centrality that measures “the extent to which a particular point lies ‘between’ the various other points in the graph [network]” (Scott, 1991, p. 89). In other words, it is regarded as a measure of the degree to which one actor can control the flow of information or conversely one can feel norm pressure, depending on the content of networks (Author, 2009). Although betweenness centrality is more appropriate for analyzing non-directed ties in general, we used betweenness centrality for the non-symmetric network in this study, based on Gould’s (1987) measures, showing that betweenness centrality can be applied to directed ties. The reason was because it enables us to investigate how teachers benefit from positioning themselves as a bridge between colleagues in their professional networks.

**PLC Measures.** Three endogenous latent variables were constructed (i.e., reflective dialogue, deprivatized practice, and organizational learning). Reflective dialogue was based on 4 items measuring the extent to which teachers regularly engage in deep discussions with colleagues about their teaching, learning, and instructional practice. Sample items included: “In this school year have you had conversations with colleagues about what helps students

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learn best?” (α = .731). *Deprivatized practice* was comprised of 3 items measuring the extent to which teachers frequently share their instructional practice through team teaching, peer coaching and classroom observation. Sample items included: “In this school year have you visited other teachers’ classrooms to observe instruction?” (α = .758) *Organizational learning* was the dependent variable in this study as well as an endogenous variable. This construct measures the extent to which teachers in the school learn collectively by looking for information, knowledge and resources, and the extent to which teachers are able to institutionalize their instructional practice and knowledge. Sample items included: “To improve my teaching, I feel that there are so many things to learn and I can never stop learning” (α = .801). Notably, its original 9 items were parceled into three indicators for (a) the parsimony of the final model, (b) the balance between measurement models and structural models, (c) the reduction of estimation errors (less unique variance), (d) the enhancement of normality of data, and (e) applicability to relatively small sample sizes (Little et al., 2002; Russel et al., 1998).

As a mediating composite variable, *individual resourcefulness* was measured for the capacity of individual learning. Specifically, this construct reflected two aspects of an individual’s capacity of being resourceful: access and use, highlighted by Van der Gaag & Snijders (2004). They described ‘access’ as some kind of catalogue of people’s stock of potential access to resources held by network members and ‘use’ as an ability people in the network have actually achieved success with the help of their network members. These analytical slices were represented through adopting Flap’s (2002) measurement approach to individual’s total resourcefulness which is constituted by three major elements: (a) number of alters in the individual’s social network, (b) the resources these alters give access to, and (c) the availability of these resources from alters to the focal individual, of which willingness of alters is a major component (cited in Van der Gagg & Snijders, 2004). The availability of
these resources involves the opportunity (i.e., frequency of contact) and the willingness (i.e., strength of contact, number of exchange or reciprocity) to access resources among members. This is represented as in the following formula (Flap, 2002):

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IR = N \times A \times P
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where \( IR \) is the quantification of an individual’s total resourcefulness, \( N \) refers to the number of network members (alter), and \( A \) refers to the number of resources items, \( A \) is a quantification of resources of type \( A \) that a network member possesses, and \( P \) is the probability (i.e., opportunity and willingness to give access to the resources) that alter \( N \) will give ego access to his resource of type \( A \). In line with this formula, individual resourcefulness was constructed to measure alters’ individual expertise and resources and alters’ ability to mobilize resources to facilitate their learning. As such, in this study individual resourcefulness is comprised of two major components: one’s expertise and resources, and the network accessibility that one can use to effectively mobilize resources. These two factors are consistent with Flap’s (2002) elements: resources and availability of these resources in terms of its accessibility (i.e., opportunity and willingness). In other words, this composite variable was calculated as ‘weighted expertise of alter \( X \) accessibility to mobilize resources.’ Specifically, the weighted expertise of an alter was computed by (normalized years of teaching of alters \( X \) \( \times .33 \)) + (normalized number of professional workshops attended by alters \( X \) \( \times .33 \)) + (normalized perception of alters’ expertise \( X \) \( \times .33 \)). Accessibility to mobilize resources was based on (the presence of reciprocity between ego and alter \( X \) \( \times .33 \)) + (normalized frequency of contact between ego and alter \( X \) \( \times .33 \)) + (normalized type or depth of interaction between ego \( X \) \( \times .33 \)); see Appendix 2 for a detailed example.

**Analytical Strategies**

After we identified an emerging theme of individual resourcefulness by analyzing open-coded initial interview data, we examined teachers’ networks. We computed key network
properties as variables, which were use later in our Structural Equation Modeling (SEM). At the next stage, we measured the level of teacher learning based on professional community and organizational learning by using Confirmatory Factor Analysis (CFA). Then, the relationships of social network properties and constructs of professional community and organizational learning constructs were explored using SEM. At the final stage, we incorporated our interview data analysis to supplement SEM analysis. Semi-structured interviews with 22 teachers were conducted for further investigations of the relationship among variables in this study.

As shown in the network map (Appendix 3), the whole school network mainly consists of three sub-networks (i.e., departments). In our analysis, as described earlier, the concept of individual resourcefulness reflects the embedded individual learning capacity derived from (a) interactive actions with the portion of actors who are adjacent ‘to’ each focal actor (i.e., outdegree centrality), and the portion of actors that are adjacent ‘from’ each focal node (i.e., indegree centrality) and (b) the important positions in the network (i.e., betweenness centrality and closeness centrality). Consequently, with the assumption of the relationship between network properties and individual resourcefulness, we consider two levels of network properties that an individual can possess: network properties from the level of the whole school and network properties from the level of the subschool components (i.e., primary, international secondary, and bilingual secondary). We assume that individuals’ network properties from the whole school as global network properties would be primarily critical to the formation of individual resourcefulness (i.e., presented by solid arrows in Figure 2). At the same time, we acknowledge that one may also argue that subnetwork properties such as departments would be more critical, which is reflected as dotted arrows; these competing assumptions were tested later. Prior to the main analysis of SEM, we checked the correlations among network properties in the proposed analytical framework.
The statistical result suggested that the measure of whole network indegree centrality has a collinearity with some of centrality measures; hence, we excluded the measure of whole network indegree centrality from the final SEM. As such, the final SEM included the following centrality measures that would influence individual resourcefulness: whole network outdegree centrality; whole network outcloseness centrality; whole network betweenness centrality (symmetrized); departmental network outdegree centrality; departmental network outcloseness centrality; departmental network betweenness centrality (symmetrized); and departmental network indegree centrality.

Using UCINET, we analyzed valued, directed data. Valuation has been measured through tie strength (frequency of discussion, depth of interaction and reciprocity of relations) and level of expertise (years of teaching experience, number of workshops attended, perception of expertise). Further analyses of network properties included density, centrality of in-degree and out-degree, centrality of betweenness, centrality of closeness (Wasserman & Faust, 1994). The network map is shown in Appendix 3.
Next, using CFA, we identified a three factor-structure of PLC, including teacher professional community (i.e., reflective dialogue and deprivatized practice) and organizational learning. As mentioned, we did not include shared responsibility in our CFA because our preliminary content validity study did not support the construct in our case study setting (see the data collection section above and Appendix 1). Based on CFA results, we sought to explore the analytical model (Figure 2) representing conceptual relationships between certain network properties, individual resourcefulness, professional community, and organizational learning constructs. For this, we used SEM that examined (a) the direct effect of network properties on individual resourcefulness, (b) the direct and indirect effects of individual resourcefulness on professional community constructs and organizational learning,
(c) the direct effect of professional community on organizational learning. In this process, mediating effects were tested using Sobel’s formula (1982).

Because some participants’ responses were not available in the data, we employed full-information maximum-likelihood (FIML) estimation to address some of the variables having missing values, ranging from 1-3%. FIML has been identified to be efficient for incomplete data in that FIML estimates are less biased than listwise deletion or pairwise deletion (Little & Rubin, 1989; Muthen, Kaplan, & Hollis, 1987; Schafer & Olsen, 1998). With respect to the normality assumptions of model, following a widely used guideline of normality (Curran, West, & Finch, 1996); although a few variables were somewhat skewed, overall, kurtosis and skewness were within acceptable bounds.

Several key indices were used to assess model fit. These included chi-square test statistic, root-mean-square-error of approximation (RMSEA), and comparative fit index (CFI). In particular, we relied more on standard cutoff recommendations for the RMSEA and CFI (Fan & Sivo, 2007; Hu & Bentler, 1999) rather than chi-square statistic, which is sensitive to sample size (Bentler, 1990a). For the RMSEA, values less than .05 and .08 suggested a good model fit and an acceptable model fit, respectively. For the CFI, an important index for studies with relatively small samples (Bentler, 1990b), values greater than .95 and .90 indicate goodness of fit and acceptable fit, respectively. Based on these criteria, we tested our proposed model.

Finally, by examining several specific propositions about paths in the model, we investigated competing models having a nested structure of our proposed model by using chi-square test statistic (see Figure 3 and Table 2).

With respect to interview data analysis, we used a continuous approach (LeCompte & Preissle 2008, p.238) where the feedback of the former interviewees helps redefining interview questions for the latter interviewees, as we gain deepened understanding of the
phenomenon under study while exploring the meanings of participants’ network behaviors. In so doing, the data collection and analysis techniques are inextricably intertwined.\textsuperscript{7}

**Results**

**Descriptive statistics**

Table 1 provides descriptive statistics of the measures used in the final analysis. The total number of participants is 101 teachers. Network properties are presented in two major groups: whole network and departmental network. This network map showed that a few actors in the network possess very high degree betweenness centrality in the whole network. In similar vein, the school network is compartmentalized by three departments and only some actors are positioned in the center of the whole network. Given the somehow overlapped formula in computing the network centrality measures, there were some modest correlations between network properties (see Appendix 4).

<table>
<thead>
<tr>
<th></th>
<th>Min.</th>
<th>Max.</th>
<th>Mean</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole network outdegree centrality</td>
<td>.000</td>
<td>.022</td>
<td>.0099</td>
<td>.0045</td>
</tr>
<tr>
<td>Whole network outcloseness centrality</td>
<td>.003</td>
<td>.013</td>
<td>.0099</td>
<td>.0018</td>
</tr>
</tbody>
</table>

\textsuperscript{7} In this interdependence process, we followed three continuing steps suggested by Lecompte and Preissle (2008): Theorizing, sequential selection strategies, and general analytic procedures. Specifically, theorizing includes examining relationship among variables based on our proposed conceptual framework and trying to explore linkages and order among them. Sequential selection strategies involve the process of selecting the focal informants such as choosing teachers with certain network positions from network map or teachers with particular prominent network properties relevant to the proposed conceptual framework. General analytic procedures are systematic means of manipulating data in order to construct the meaning from data derived throughout the research process.
<table>
<thead>
<tr>
<th></th>
<th>SEM Results</th>
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<tr>
<td>Whole network betweenness centrality</td>
<td><img src="https://example.com/table.png" alt="Table" /></td>
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<tr>
<td>Departmental outdegree centrality</td>
<td><img src="https://example.com/table.png" alt="Table" /></td>
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<tr>
<td>Departmental outcloseness centrality</td>
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<td>Departmental indegree centrality</td>
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</tr>
<tr>
<td>Individual resourcefulness</td>
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<tr>
<td>Organizational learning</td>
<td><img src="https://example.com/table.png" alt="Table" /></td>
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<tr>
<td>Reflective dialogue</td>
<td><img src="https://example.com/table.png" alt="Table" /></td>
</tr>
<tr>
<td>Deprivatized practice</td>
<td><img src="https://example.com/table.png" alt="Table" /></td>
</tr>
</tbody>
</table>

N = 101

A CFA measurement model, consisting of three latent variables (i.e., reflective dialogue, deprivatized practice, and organizational learning) was first analyzed. Results indicated that all the indicating variables loaded significantly on their respective factors with the CFI of .901 and chi-square ($\chi^2$) $=57.38$, df $= 32$ (see Appendix 5 for more details about the measurement model); Cronbach alphas were .801 (Organizational Learning), .731 (Reflective Dialogue), and .758 (Deprivatized Practice). Based on the CFA measurement model, we constructed our structural model by reflecting our conceptual framework discussed earlier (Figure 2). Alongside this hypothesized model, we further explored possible competing models (McDonald & Ho, 2002). We tested significance on differences between proposed model and alternative models using chi-square test statistic. The proposed model (Figure 3a) was developed under the premise that, in this case school, teacher’s professional networks may occur in two levels: (a) whole network and (b) departmental network levels. Therefore, both types of network properties were included in the model. In this proposed
model (Figure 3a), we further assume that those network properties were solely associated with individual resourcefulness and individual resourcefulness extended its effect on professional community and organizational learning. We then investigated an alternative model (competing model I) in which we drew connections of network properties to professional community and organizational learning constructs (Figure 3b). We then tested our premise by withdrawing whole network properties from the proposed model but still retaining the connections from departmental network properties to professional community and organizational learning constructs in the model (competing model II, Figure 3c).

Specifically, we deleted whole network properties in the model given that one may argue that teachers are likely to work more closely with other teachers within the same department level rather than other teachers across different departmental boundaries. In the final model comparison (Competing model III, Figure 3d), we deleted the paths from network properties to professional community and organizational learning (competing model III, Figure 3d) testing the possible impact of teacher’s departmental-level network behaviors on professional community and organizational learning when solely mediating through teacher’s resourcefulness.
As presented in Table 2, chi-square test statistic indicated that there were no significant differences between the proposed model and the 3 competing models. Rather, the proposed model demonstrated a slightly better model fit with model parsimony. With respect to model fit, the RMSEA values of the proposed model were .063; the CFI values were .922. Based on the standard cutoff recommendations described earlier (Fan & Sivo, 2007; Hu & Bentler, 1999), the indices showed that the overall model fit was reasonably good.

Table 2. SEM properties comparison of proposed and competing models

<table>
<thead>
<tr>
<th>Model</th>
<th>Chi-square</th>
<th>df</th>
<th>CFI</th>
<th>RMSEA</th>
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</thead>
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<tr>
<td>Proposed Model</td>
<td>153.61</td>
<td>110</td>
<td>.922</td>
<td>.063</td>
</tr>
<tr>
<td>Competing Model I</td>
<td>135.85</td>
<td>89</td>
<td>.916</td>
<td>.073</td>
</tr>
<tr>
<td>Competing Model II</td>
<td>105.79</td>
<td>68</td>
<td>.889</td>
<td>.075</td>
</tr>
<tr>
<td>Competing Model III</td>
<td>113.09</td>
<td>80</td>
<td>.902</td>
<td>.064</td>
</tr>
</tbody>
</table>
Based on the results of the model comparisons, we maintained our proposed model to test our original hypotheses. The data fit the proposed model well: CFI = .922, RMSEA = .063, $\chi^2 = 153.6$, df = 110. Based on the model fit indices, Figure 4 present SEM results of the model with standardized beta coefficients, $r$ squared, and correlation coefficients (see also Appendix 5 for details about path coefficients, standard errors, and $p$ values).

Figure 4. Structural equation model

Note: Error terms and factor loadings in the measurement model part were omitted for simplified presentation. For details about the measurement model, see Appendix 5.
Results indicated that of seven network properties, whole network outdegree centrality had a strong direct effect (.898, \(p < .001\)) while departmental outdegree centrality had a direct effect (.157, \(p < .001\)) on individual resourcefulness. Whole network betweenness centrality also showed a significant direct effect on individual resourcefulness (.085, \(p < .05\)), however, departmental betweenness centrality did not have a significant effect on individual resourcefulness. Neither did whole network outdegree closeness centrality nor departmental outdegree closeness centrality. Departmental indegree centrality did not have significant direct effect on individual resourcefulness.

Whole network outdegree centrality showed an indirect effect to reflective dialogue mediating through individual resourcefulness. To confirm the indirect effect, the Sobel’s test was applied using the following formula (Sobel, 1982).

\[
\frac{a \times b}{\sqrt{a^2 + b^2}}
\]

where \(a\) is the unstandardized path coefficient from whole network outdegree centrality to individual resourcefulness (89.444), \(b\) is the unstandardized path coefficient from individual resourcefulness to reflective dialogue (.157), \(a\) is the standard error of \(a\) (3.821), \(b\) is the standard error of \(b\) (.070). As such, the sobel’s test indicated a significant indirect effect: \(z = 2.23, p \text{ value } .025\). This suggests that the relationship between whole network outdegree centrality and reflective dialogue was mediated through individual resourcefulness. The model also suggested an indirect effect from departmental outdegree centrality to reflective dialogue (RD) mediating through individual resourcefulness using the Sobel’s test noted above, the indirect effect was tested: \(z = 1.97, p \text{ value } .049\) (see Appendix 6 for details).

While we assume the relationships between individual resourcefulness and professional community constructs, individual resourcefulness only had a direct effect on reflective dialogue (.261, \(p \text{ value } .05\)). In other words, there was no significant direct effect of
individual resourcefulness on deprivatized practice. However, whole network betweenness centrality had no significant indirect effect on reflective dialogue, mainly due to its small path coefficient to individual resourcefulness.

Unlike our assumption, there was no direct effect from individual resourcefulness on organizational learning construct. The model, however, revealed an indirect effect of individual resourcefulness to organizational learning via reflective dialogue ($z =1.77, p$ value at a borderline level of .076). Finally, when examining the relationship between professional community and organizational learning constructs, the model showed a significant direct effect of reflective dialogue on organizational learning (.441, $p$ value .01). However, there was no significant direct effect of deprivatized practice on organizational learning.

Discussion

In response to the dearth of research on teacher network and professional learning communities in relation to teacher learning (Little, 2003; McCormick, 2011), we examined teachers’ interactions and dynamics in connection with the development of professional community and organizational learning in schools. In this process, we adopted a fresh concept, individual resourcefulness, representing the capacity of teacher learning. We used it as a mediating concept to link teachers’ network properties and the development of professional community and organizational learning. In doing so, we were able to examine the process of how teacher professional relationships and collegial interdependence affect the learning level of organization. In addition, the study demonstrated the mechanism of how two characteristics under the behavioral domain of professional community – deprivatized practice and reflective dialogue – support the development of organizational learning in this case school. As we investigated this series of inquiries by setting up the three hypotheses, our discussion is aligned to them as below.

Hypothesis 1
We hypothesized that network properties of individual teachers will have a direct effect on the formation of individual resourcefulness. Results indicated that certain network properties turn out to be important for the formation of individual resourcefulness on instruction. Specifically, individual teachers' effort to mobilize or seek instructional advice/information (i.e., the significance of outdegree centrality) is crucial for obtaining instructional advice/information, which in turn fosters reflective dialogue. This finding can be extended to compare teacher’s interdependence between whole school and department contexts. As the direct effect of whole network outdegree centrality is much larger than the effect of departmental outdegree centrality on individual resourcefulness, we may suggest that although making a contact with teachers in the same department helps in building up individual resourcefulness, it tends to be more effective for teachers to look for instructional advice/information in the whole school rather than only in their department.

With respect to betweenness centrality, given betweenness centrality refers to individuals’ network positions linking different subgroups in the organization, teacher’s network position to bridge colleagues across departments helps that teacher to obtain more advice/information as whole network betweenness centrality showed significant direct effect on individual resourcefulness while departmental network betweenness centrality did not. Hence, teachers whose positions as bridges between departments possess more important network role than those who are brides within their own department (i.e., the significance of whole network betweenness centrality).

In terms of increasing one’s resourcefulness in relation to outdegree closeness centrality, it is not important whether teachers can get to individual teachers/administrators who are located in the center of the school and department network, given that whole network outdegree closeness centrality and departmental network closeness centrality were not significant.
Hypothesis 2

We hypothesized that individual resourcefulness will have direct and indirect effects on teacher professional community and organizational learning. First, we look at the direct effect of individual resourcefulness on organizational learning. The insignificance of individual resourcefulness on organizational learning suggested that knowledge and resources embedded in individual teachers are not simply transformed or converted into organizational level of learning. The data from interviews suggested that one of the reasons why the developed expertise was likely locked within the individual level in this case school might stem from the impracticality of the existing customized curriculum mapping platform that is purposely used as a tool for teachers to share resources collectively. The interviews with teachers in the school provided consistent comment that although the platform is useful for new teachers and administrators to monitor the whole school teaching, the platform does not facilitate the sharing process among them instead it creates more work for teachers to update and renew their teaching plans. In addition, interviews were conducted in the early stage of implementing this curriculum platform. Therefore, the focus was mainly data entry in which teachers were required to frequently update their plans into the system.

Teacher A: Curriculum mapping…uhm…also… you can see at the beginning of the year…so that…you can see what everybody is doing, right? Uhm…it helps [school administrator X] [school administrator Y] to understand what’s going on. Uhm…it’s also good for teachers when you come in to the job, I think it’s useful because you inherit the class, a bunch of documents, a bunch of unit plans. You can see what the past years teacher have done or the teachers two years ago have done. But it constantly needs updating. Uhm…so for me personally, any time I change anything in my unit plan, I need to go to Atlas Rubicon and update it. So, it’s a lot…of work to update.
Teacher B: Rubicon…you know… roughly involves curriculum planning. It is supposed to be the place to deposit resources and organize curriculum which I think it does. I think, on a day-to-day usage, it’s not particularly useful for me. At the end of the unit, whatever I changed or fixed then I go and upload it onto. It’s a job. But I don’t use it in my day-to-day planning. For me, it’s not personally useful.

As the literature pointed out, organizational learning can be interpreted as the construction of meaningful contexts and conditions under which routines are properly shared and collectively practiced (Louis, 2006). Although the administration in this case school aimed to establish this curriculum mapping platform in order to promote routine sharing and exchanging of resources and to provide conditions under which routines are properly shared and collectively practiced; unfortunately, the complication of functions and technicalities of the platform supersede its purpose and instead creates additional work for teachers to complete the required tasks on top of their busy schedule.

In addition, there was a significant direct effect of individual resourcefulness on reflective dialogue. Taken together with the finding that there is an indirect effect of both whole network outdegree centrality and departmental network outdegree centrality on reflective dialogue mediating through individual resourcefulness, this analytical outcome supports Bryk et al. (1999)’s study that professional community can be formed when teachers regularly engage in deep discussions about instructions with colleagues. However, there was no significant effect of individual resourcefulness on deprivatized practice. This suggested that routinized discussions about instruction, embedded in school members’ advice/information networks, do not necessarily lead them to “open” their classroom teaching to their colleagues to exchange feedback or ideas on instruction and teaching. From the

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8 Atlas Rubicon is a customized web-based curriculum management tool which is considered to be one of the electronic platforms to support collaboration among teachers. It is widely used in international schools to facilitate the process of curriculum mapping in which the whole school curriculum can be stored and shared.
interviews, although most teachers agree that classroom observation and co-teaching are useful, many teachers in this school however still feel reluctant to open up their classes. Derived from interviews, three major reasons are the feeling of intrusion, existing unclear appraisal process in the school, and schedule conflict.

Teacher C: Teachers are fairly territorial people. Some of them are really fiercely independent. So, they think of their classroom is like their castle. Some…you know…I think that might be the response.

Teacher D: This is tricky, I think that some of it comes from the school culture, some of it might come from the fear that..uhm…people are gonna evaluate and rank you…uhm…..so, sometimes people resist that idea. I think that we have a somewhat unclear evaluation process at this school. Then, those types of things (classroom observation) make you wonder or worry…may be…I think.

Teacher E: Basically, you choose the time that is most convenient for you. Timing is the factor. I mean…I wanted to see [teacher X] a number of times and he came to visit me. It took us about four weeks to find the time when he was available and I was available because we were just so busy. Schedule makes it difficult like I can’t see some teachers because they are always teaching when I am.

Although there exists an awareness that team teaching, peer coaching and classroom observation would positively lead to an improvement in both classroom and collegial relationship (Louis, Marks, et al., 1996), the interview data suggested that deprivatized practice cannot be simply promoted in this case school. The above data further implied that deprivatized practice might be better fostered through other mechanisms such as formal school initiatives/intervention or heightening levels of trust (both individual and institutionalized trust among school staff).
Concerning the indirect effect, results showed the significant indirect effect of resourcefulness on organizational learning mediated through reflective dialogue at the borderline level. Taken together with the finding of no direct effect of resourcefulness on organizational learning, it can be said that teachers' resourcefulness may be effective on an organizational level of learning when their resourcefulness for one another is mediated with dialogue-based interactions.

**Hypothesis 3**

We hypothesized that teacher professional community will have a direct effect on organizational learning. Results show that reflective dialogue was a key component for organizational learning in the case school. Analytically, reflective dialogue has a direct effect on organizational learning. From the interview data, most interviewed teachers also believe that they learn by engaging in deep discussions about instructions with their colleagues.

Below is the interview data from one of the secondary Mathematics teachers.

Teacher F: In this school, I worked a lot with [teacher X and Y] ideas about math. I talk to [teacher Z] a lot as well about vocabulary strategy and help the students right. I do interact with many teachers and share some ideas. I often like to listen to unique ideas that they have. I don’t always follow them. I will think and decide if I really want to do that activity. But I think the more that people share the better because you are not gonna like everything, but the more information you have the more… even just bits and pieces you can pick out.

However, there was no significant direct effect of deprivatized practice on organizational learning. Although, in theory both reflective dialogue and deprivatized practice are two major characteristics that promote collaboration and consequently leads to professional community (Louis, Marks, et al., 1996), for this case school we may conclude that only reflective dialogue plays crucial role in promoting organizational learning.
Implications for Research and Practices

While this study is a single case study with cross-sectional analysis, which is obviously a limitation of this study, there is a number of implications for research and practices. First, as the first of its kind, results illuminated the linkages between network properties and the development of PLCs and such linkage is mediated through individual resourcefulness. In particular, studies aiming to delve into individual resourcefulness can benefit from our study as an empirical base.

Second, results show the insignificant linkages between deprivatized practice and organizational learning, contradictory to the significant linkage between reflective dialogues and organizational learning. This finding complicates existing relationships among sub-constructs of PLC. One likely reason may be the unique setting of this study; an international school located in East Asia in which teachers tend to be more territorial and expect more ownership of their classroom. At the same time, however, this suggests that school management may need to find ways to promote trust among teachers in order to elevate sense of security which in turns encouraging teachers to feel more comfortable to open up their class for practice sharing. By heightening the level of trust, it is likely that the significant relationship between individual resourcefulness and deprivatized practice can be improved. This may subsequently improve the effect of deprivatized practice on organizational level of learning (Louis, 2006).

Third, our initial validation procedure suggested that shared responsibility as a PLC sub-construct was not salient in the school context. Future studies on a larger scale in international schools in Asia should further delve into this finding, implying the possibly different configuration of PLC in this regional (i.e., Asia) and schooling (i.e., IB school) contexts. This will enrich research literature on PLC.
Fourth, this study could serve as a solid foundation for researchers who focus on international school settings, given that international schools in Asia has evidenced the fastest growth, compared to any other schooling systems around the world (Lee, Hallinger, & Walker, 2012).

In terms of practices, firstly, results from our analysis suggest that school leaders in international schools may need to focus more on changing school climate that genuinely promote deprivatized practice, given that deprivatized practice was, surprisingly, not a significant predictor of organizational learning. This may be because the personal factor that teachers tend to be territorial or the external factor due to an existing unclear appraisal process in this case school, suggested by interview data. Hence, teachers are not sure whether they would be evaluated when opening their class for practice sharing purpose. Although this suggestion may be confined to this particular case school, definitely not to all international schools in Asia, it is worth considering for school management.

Secondly, the insignificant linkages between individual resourcefulness and organizational learning. From the interview data to explore the insignificance among these two variables, the school’s effort to transform individual resources to organizational expertise was not successful as the customized platform that has been introduced for this purpose seems to be too complicated for teachers to maneuver and it requires daunting tasks for teachers to complete. In short, teachers perceive it as another checklist of the job to be completed rather than as a tool to facilitate their collective learning.

Finally, implications are offered about how to promote organizational learning. Findings suggest that teachers in the school engage in various discussions that lead to the development of professional community. However, teachers are reluctant to share their practices through classroom observation and co-teaching. We may interpret that reflective dialogue is well developed while deprivatized practice is still in the initial stage in this
school. Beyond this descriptive diagnosis, however, further analysis must be conducted to measure the contribution of how deprivatized practice would affect organizational learning after a successful promotion of deprivatized practice.
References


Fielding, M., Bragg, S., Craig, J., Cunningham, I., Eraut, M., Gillinson, D., . . . Thorp, J.


Toole, J. C., & Louis, K. S. (2002). The role of professional learning communities in
international education. In K. Leithwood & P. Hallinger (Eds.), *Second international handbook of educational leadership and administration* (Vol. 1). Dordrecht: Kluwer Academic Publisher.


**Appendix 1. Content Validity Ratio**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Survey items</th>
<th>CVR ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Organizational Learning (OL)</strong></td>
<td>OL1: I show initiative to identify and solve problems.</td>
<td>0.64</td>
</tr>
<tr>
<td></td>
<td>OL2: I share current findings in Education with my colleagues.</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td>OL3: I seek out and read current findings in education.</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td>OL4: After attending professional development activities this past year, I discussed what I learned with other teachers in my school who did not attend the activity.</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td>OL5: After attending professional development activities this past year, I discussed or shared what I learned with administrators.</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>OL6: After attending professional development activities this past year, I made changes in my teaching practice.</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td>OL7: When planning for my lesson, I accept and try new ideas given by my colleagues.</td>
<td>0.64</td>
</tr>
<tr>
<td></td>
<td>OL8: I look for my director for guidance and/or advice to support my teaching.</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td>OL9: When my teaching goes wrong, I will try to find reasons and find ways to improve it.</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td>OL10: I use student’s feedback and learning outcomes to tailor my lesson plan.</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>OL11: To improve my teaching, I feel that there are so many things to learn and I can never stop learning.</td>
<td></td>
</tr>
<tr>
<td><strong>Shared Responsibility (SR)</strong></td>
<td>SR1: I meet with other teachers to collaboratively plan.</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td>SR2: I help maintain discipline in the entire school, not just my classroom.</td>
<td>0.09</td>
</tr>
<tr>
<td></td>
<td>SR3: I take responsibility for improving the school outside my own class.</td>
<td>-0.09</td>
</tr>
<tr>
<td></td>
<td>SR4: I feel responsible to help each other improve our instruction.</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Reflective Dialogue (RD)</strong></td>
<td>RD1: In this school year, have you had conversations with colleagues about what helps students learn best?</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>RD2: In this school year, have you had conversations with colleagues about development of new curriculum?</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>RD3: In this school year have you had conversations with colleagues about the goals of this school?</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td>RD4: In this school year, have you exchanged suggestions for curriculum materials with colleagues?</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Deprivatized Practice (DP)</strong></td>
<td>DP1: In this school year, have you visited other teachers’ classrooms to observe instruction?</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>DP2: In this school year have you received meaningful feedback on your performance form colleagues?</td>
<td>0.64</td>
</tr>
<tr>
<td></td>
<td>DP3: In this school year, have you had colleagues observe you classroom?</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td>DP4: In this school year, have you invited someone to help teaching your class(es)?</td>
<td>0.27</td>
</tr>
</tbody>
</table>

*Minimum CVR value is .59 when there are 11 teachers participating in the survey validation process (Lawshe, 1975) *

Appendix 2. Calculation of Individual Resourcefulness
As illustrated in the figure above, for example, the individual resourcefulness of Alice in the figure above derived from her five most important colleagues was 1.11 based on the following calculation: \( \{ \text{Person 1’s weighted expertise (}.695) \times \text{accessibility with person 1 (}.748) \} = .520 \). As this individual resourcefulness is a collection of all potentially available network resources of the focal alter, we operationalize the value as the total sum of all accessible resources of each contact (i.e., number of network members) that reflect the composite value as \( 1.11 = \text{Person 1’s accessible resources (}.520) + \text{Person 2’s accessible resources (}.176) + \text{Person 3’s accessible resources (}.125) + \text{Person 4’s accessible resources (}.164) + \text{Person 5’s accessible resources (}.127) \).
Appendix 3 School network visual map
### Appendix 4. Correlation matrix among variables in the model

<table>
<thead>
<tr>
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<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<tbody>
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<td></td>
</tr>
<tr>
<td>2. Whole network outcloseness centrality (NOutcloseness)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.382**</td>
<td></td>
<td></td>
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<tr>
<td>3. Whole network betweenness centrality (NBetweenness)</td>
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<td>4. Departmental outdegree centrality (DOutdegree)</td>
<td>.115</td>
<td></td>
<td>-.131</td>
<td></td>
<td>.232*</td>
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<td>5. Departmental outcloseness centrality (DOutcloseness)</td>
<td>.141</td>
<td>.423**</td>
<td>-.089</td>
<td>-.071</td>
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<td>6. Departmental betweenness centrality (DBetweenness)</td>
<td>.333**</td>
<td>.043</td>
<td>.132</td>
<td>.396**</td>
<td>.203*</td>
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<td>7. Departmental indegree centrality (DIndegree)</td>
<td>.518**</td>
<td>.269**</td>
<td>-.057</td>
<td>.027</td>
<td>.651</td>
<td>.269**</td>
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<td>8. Individual resourcefulness</td>
<td>.919**</td>
<td>-.314**</td>
<td>.217*</td>
<td>.215*</td>
<td>.113</td>
<td>.362*</td>
<td>.460**</td>
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<tr>
<td>9. Organizational learning</td>
<td>.100</td>
<td>.164</td>
<td>.121</td>
<td>.090</td>
<td>.050</td>
<td>-.092</td>
<td>-.080</td>
<td>.169</td>
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<td>10. Reflective dialogue</td>
<td>.223*</td>
<td>.096</td>
<td>.142</td>
<td>.161</td>
<td>-.033</td>
<td>.081</td>
<td>-.011</td>
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<tr>
<td>11. Deprivatized practice</td>
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<td>.106</td>
<td>.098</td>
<td>.151</td>
<td>.144</td>
<td>.039</td>
<td>.104</td>
<td>.112</td>
<td>.265*</td>
<td>.351**</td>
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Note: N = 101 **p < .01, *p < .05 (2-tailed)
## Appendix 5 Path coefficients, standard errors, and $p$ values

<table>
<thead>
<tr>
<th>Direct effects</th>
<th>Standardized estimate</th>
<th>SE</th>
<th>$p$ value</th>
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<tbody>
<tr>
<td>Whole network outdegree centrality $\rightarrow$ Individual resourcefulness</td>
<td>.898***</td>
<td>3.821</td>
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<td>Whole network outdegree closeness centrality $\rightarrow$ Individual resourcefulness</td>
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<td>.001&lt;</td>
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<td>1.736</td>
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<td>Departmental network betweenness centrality $\rightarrow$ Individual resourcefulness</td>
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<td>.454</td>
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<tr>
<td>Departmental network indegree centrality $\rightarrow$ Individual resourcefulness</td>
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<td>1.232</td>
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<td>Individual resourcefulness $\rightarrow$ Reflective dialogue</td>
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<td>.070</td>
<td>.025</td>
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<tr>
<td>Reflective dialogue $\rightarrow$ Organizational learning</td>
<td>.441**</td>
<td>.215</td>
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<td>Individual resourcefulness $\rightarrow$ Deprivatized practice</td>
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<td>.166</td>
<td>.107</td>
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<td>Individual resourcefulness $\rightarrow$ Organizational learning</td>
<td>.028</td>
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<td>Deprivatized practice $\rightarrow$ Organizational learning</td>
<td>.212</td>
<td>.075</td>
<td>.101</td>
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## Appendix 6 Indirect effects and $p$ values

<table>
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<th>Indirect effects</th>
<th>Sobel’s test</th>
<th>$p$ value</th>
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<td>1.77</td>
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