Being Connected: How a Relational Network of Educators Promotes Productive Communities of Practice

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BEING CONNECTED: HOW A RELATIONAL NETWORK OF EDUCATORS PROMOTES PRODUCTIVE COMMUNITIES OF PRACTICE

Dissertation

by

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ABSTRACT

In this dissertation study, I examined the extent to which a relational network of teachers, administrators, two-way immersion (TWI) experts and mentors promote productive communities of practice (CoP). In a conventional instruction, teachers are often isolated in their classrooms, and a private practice culture prevails. In 2012, the Two-Way Immersion Network for Catholic Schools (TWIN-CS) was launched in an effort to support school reform by engaging school leaders and teachers to collectively learn toward implementing TWI models in their schools.

Using the framework of communities of practice (Lave & Wenger, 1991; Wenger, 1999), I employed a case study design (Yin, 2009) to explore a national network of Catholic elementary school educators. Data sources included qualitative data featuring semi-structured interviews and quantitative source from a relational network survey.

Qualitative results revealed that organizational features of TWIN-CS are critical in promoting participants' learning to implement TWI. In particular, participants discussed the annual TWIN Summer Academy and bi-monthly webinars to be instrumental for their learning. Many participants also shared that an expansion of CoPs beyond TWIN-CS further prompted productive learning. However, the qualitative evidence also showed a lack of clear internal and external network structures and role definition, and sustaining connection beyond the Summer Academy and webinars were perceived as a great challenge. Quantitative results suggest that TWIN-CS has a core-and-periphery network structure with the Boston College design team at the innermost core, with visibly dense ties connecting to and from them. Most teachers, on the other hand, occupy the most peripheral positions in this network. Survey evidence also showed that participants generally perceived a much stronger learning relationship within schools and showed less certainty on cross-network relationships. In terms of learning characteristics, majority of the respondents viewed knowledge sharing, trust, and advice-oriented dimensions "strongly" but perceived a lack of data-driven learning for both within school and cross-network.

I conclude this study with a discussion of implications for future research and practice.

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Chapter 1: Introduction

Background

Growing Needs of Culturally and Linguistically Diverse Students

Over the past several decades, various ethnic populations expanded, and the demographic landscape has diversified in the United States (Hernandez, Denton, & McCartney, 2009; Howard & Christian, 2002). In the United States, classrooms have experienced remarkable cultural and linguistic growth in recent decades. Inevitably, such a phenomenon led to increased awareness of the growing needs of this demographic expansion. For example, approximately one in five Americans will be an immigrant by 2050, compared to the current proportion of one in eight (Passel & Cohn, 2008).

The immigrant population in the United States is also expected to rise to 81 million in 2050, a growth of 125% from 36 million people in 2005 (Passel & Cohn, 2008). Furthermore, the Hispanic/Latino population is projected to reach about a quarter of the entire U.S. population by the year 2050 (Lindholm-Leary, 2005). The majority of this Hispanic/Latino population is expected to enter school without proficiency in the English language (Lindholm-Leary, 2005). These demographic trends clearly demonstrate that the culturally and linguistically diverse (CLD) student population is growing (Hernandez et al., 2009). It is imperative to effectively educate this population, and yet CLD students are consistently underserved by our schools (Garcia & Cuellar, 2006).

The changing demographics toward a sizeable growth in the CLD student population are evident. However, several studies have argued that the current U.S. educational system does not serve the needs of CLD students. Such CLD population growth was reliably forecasted since at least the1980s (Medina, 1988). Garcia and Cuellar argued that despite this, the current educational system continues to be "at risk" due to the growing number of CLD students (Garcia & Cuellar, 2006). Lee and Buxton (2011) added to this claim by raising concerns among many school leaders in regard to how the learning needs of the CLD students should be met and about the achievement gap between CLD and mainstream students (native English speakers, White, and middle-to-high income families).

CLD students, many from immigrant backgrounds, face great challenges. According to the National Center for Educational Statistics (NCES, 2011¹), the drop-out rate for Latino high school students is higher (14%) compared to White (5%) and Black (7%) students, suggesting that current educational efforts are not meeting the needs of these students. In recent years, however, services for these diverse populations diminished considerably in both public and private institutions, despite the rapid increase in the number of school-age children from different cultural and linguistic backgrounds (de Jong, 2011). Moreover, Harper, de Jong, and Platt (2008) found that policymakers often paid very little attention to issues pertaining to second language acquisition, bilingualism, or cultural identity while even more demanding concepts of inter-language, cross-linguistic transfer and cultural ambivalence were rarely addressed.

To meet the changing dynamics of demographic trends, a wide variety of innovative educational ideas emerged. One example is two-way immersion (TWI) instruction (Hamilton, 2008). TWI "integrates native English speakers and native speakers of another language for content and literacy instruction in both languages" (Howard & Christian, 2002, p. 1). Despite the projected spike in demand in the United States, however, the TWI model is not widespread (Center for Applied Linguistics, 2012).

¹ <u>http://nces.ed.gov/fastfacts/display.asp?id=16</u>

Isolated Teaching Practices

To support a TWI instructional model, some schools created networks to share resources to enhance instructional practices and professional development via collaborative learning. Although some networks or groups of schools and teachers did come together for professional development purposes for some time (HaLevi, 2011), the formation of an intentional, supportive learning community of TWI schools is relatively rare. A major reason for this lack of TWI networks is that, currently, teachers are often isolated in their classrooms and their schools with too much of a private practice culture prevailing (Lortie, 1975; Nieto, 2003; Sindberg, 2011).

Based on her interviews and observations with classroom teachers, Nieto (2003) argued that teaching is perhaps one of the loneliest professions in existence because teachers spend much of their time in isolation with students without much interaction with their colleagues. If any interaction exists, it is mostly superficial. Nieto (2003) also found that "in many schools teaching is still considered a solitary craft, and a sense of community is missing" and that the pervasive perception of teaching as a private effort must be challenged (p. 78).

Research has shown that the practice of teaching and student learning outcomes are strengthened through collective questioning of ineffective teaching routines, the pursuit of new and creative ways of teaching and learning, and active engagement in supporting one another's professional growth (Darling-Hammond et al., 2009; Grossman, Wineburg, & Woolworth, 2001; McLaughlin & Talbert, 2001; Stokes, 2001). However, many teachers across America teach with little to no peer interaction (Rasberry & Mahajan, 2008). Although some teachers assume complete control over their instruction, the range of their practice and influence is typically confined to their classrooms, and opportunities to collaborate with colleagues are limited (Rasberry & Mahajan, 2008).

A Network of Two-Way Immersion schools

Developed in 2012 by a team of experts brought together by the Roche Center for Catholic Education at Boston College, the Two-Way Immersion Network for Catholic Schools (TWIN-CS) is a multiyear project for creating a nationwide network of Catholic elementary schools transitioning from monolingual to dual language environments by implementing TWI models. TWIN-CS started through a competitive application process and acceptance period during the fall semester of 2012. This process led to the acceptance of ten Catholic elementary schools from across the United States. The TWIN-CS Academy was formally launched during the spring semester of 2013. TWIN-CS represents the first coordinated effort to support school reform by employing a network of communities of practice (Scanlan, Kim, Burns & Vuilleumier, 2016).

Although the TWI model has become increasingly popular in educational settings since the 1990s (Howard & Christian, 2002; Howard & Sugarman, 2007), TWIN-CS provides a collegial environment for supporting teachers and schools to enhance the achievement of educationally underserved CLD students (Weitzel-O'Neill & Torres, 2011). Participation in TWIN-CS requires a great deal of input from schools and extensive support from university researchers and TWI experts. The creative structure of this collective learning community of teachers helps schools to better serve their students. The literature shows that employing a network structure may help otherwise isolated principals, teachers, and schools to achieve educational change in communities of practice (Little, 2005; Niesz, 2007).

Brass (2012) defined a network as a group of individuals, called actors or nodes, whose ties represent the presence or absence of relationships between the nodes. These kinds of relationships are often investigated through network analysis. The goal of network analysis is to collect data about the relational structure of a network by illustrating patterns of interpersonal connections, influence, flow of information, and exchange of resources.

Conceptual Framework

A key framework for this study is the conceptual framework of communities of practice (CoP). Wenger (1999) defined CoPs as groups of people who engage in a process of collective learning in a shared domain of human endeavor by disclosing their concerns or passion for something they do and learning how to do it better through regular interaction. In all cases, the key elements of CoPs are,

- **The domain**: Members are brought together by sharing a domain of interest. This shared learning need may be explicit or more informal and a desire to learn about the domain could be the motivation for their collegial bonding or simply a by-product of it.
- **The community**: Participants engage in collegial activities, discussions, and professional development by helping each other and by sharing information. Over time, they build a bond that enables them to learn from each other. They do not necessarily collaborate very frequently, such as on a daily basis, but the key focus is to interact and learn together.
- **The practice**: Members are practitioners. Their interactions produce a shared repertoire of resources that affect their practice. These resources may include experiences, learning tools, and ways of communicating and addressing problems.²

This conceptual understanding of networks as professional communities is built on the theory that learning is a by-product of social participation (Lieberman & Wood, 2003; Niesz,

² <u>http://wenger-trayner.com/resources/what-is-a-community-of-practice/</u>

2007). Consequently, CoPs theoretically create a powerful environment for learning. Therefore, it is worthwhile to examine the presence of CoPs within and across a network of schools engaged in transforming their service delivery model for CLD students. Moreover, clear understanding and implementing of CoPs could be helpful towards mitigating isolation factors.

From one viewpoint, TWIN-CS is a large community of practice: a collegial network of educators striving to effectively implement a TWI model. During the first year of implementation, all TWIN-CS schools experienced professional development through face-toface meetings and virtual support provided in both synchronous (webinars) and asynchronous (social media and LISTSERV) formats. From another viewpoint, each member represents multiple communities of practice, including school administrators, teachers, and TWI implementation experts assigned to each member school and referred to as "TWI mentors." Moreover, each network school could be considered a community of practice unto itself. These multiple layers of TWIN-CS provide a rich context to study how educators strive to improve schooling within a constellation of CoPs for improving education. Therefore, the objective of TWIN-CS is to establish a well-designed network of TWI schools, collaborate with peer institutions, and provide excellent and holistic education to CLD students.

Over the past 2 years, the research design team, consisting of faculty, staff, and graduate students affiliated with the TWIN-CS initiative, has conducted a study to examine the emergence of CoP in TWIN-CS. As a graduate assistant for TWIN-CS, I participated in this initial study, and my dissertation will further contribute to its agenda.

The core interest of this dissertation emerged from the premise that the steadily growing CLD student population in the United States is being underserved by the traditional school system. Among the several ways to address this challenge, TWI education is gaining in popularity as one promising model for educational researchers and practitioners. However, school reform intended to serve the needs of CLD students is hard to come by in a traditional school setting. Specifically, teachers are often isolated in their classrooms and their schools, with too much of a private practice culture prevailing. The TWIN-CS design represents a coordinated effort to support school reform by employing a network of CoPs. Therefore, the aim of this dissertation is as follows:

To investigate the extent to which a relational network of teachers, administrators, and TWI implementation mentors promote productive communities of practice engaged in implementing and transforming into TWI instruction models.

Research Questions

(1) Do the organizational features of TWIN-CS facilitate productive learning among participants implementing TWI models? If so how?

The first question attempts to identify the key organizational features of TWIN-CS. Because TWIN-CS is a joint enterprise of educators serving the educational needs of CLD students, it makes sense to first examine the structural mechanism of this network.

(2) What are the characteristics of relational networks among participants in TWIN-CS?

After identifying and analyzing the organizational features of TWIN-CS, it is then important to focus on understanding individual participants' relationships within the network. Examining the relationships through a network analysis will provide quantitative data to understand the frequency and magnitude of the flow of information among participants. Moreover, answering the second question will identify the extent of each participant's role within TWIN-CS and how the role is a factor in promoting collective learning. (3) How are the individuals' roles associated with promoting a perceived productivity within communities of practice in implementing a TWI model?

After analyzing the key organizational features of TWIN-CS and examining the patterns of interpersonal connections to identify participants' roles, the third research question will ask for in-depth details from individual participants of TWIN-CS about their roles identified through the second research question.

Significance of the Research

This study aims to inform the growing interest in network analysis, communities of practice, and TWI education. Despite the research demand, there is a gap in the literature regarding the relationship of CoPs and relational network of schools serving the needs of CLD students using TWI models.

One of the most important objectives of this study was to analyze how TWIN CoPs emerged within schools that did not have a history of serving CLD students in their communities by implementing underdeveloped models such as ESL only models or absence of any model. The findings from this study can speak to issues of school transformation in the context of capacity building or implementation of new curricular models to meet the needs of changing student demographics.

Another area in which this study can be useful is Catholic school education. Historically, Catholic schools have underserved the educational needs of CLD students (Scanlan & Zehrback, 2010). Unlike some public schools that have implemented service models for CLD students, Catholic schools did not employ any models to address their growing educational needs. TWIN-CS is the first national network of Catholic schools to form a relational network of educators, researchers, and practitioners with the agenda of advocating productive CoPs and authenticating sound service delivery models for CLD students.

TWIN-CS is the first intentionally formulated national network of Catholic schools transitioning from traditional instruction to TWI models, and stakeholder interests in this network influenced the formation of this dissertation. Hesse-Biber (2010) suggested that researchers should consider the concerns or interests of individuals that provide funding, and resources and that the interests of these stakeholders may shape the research direction. Because I am a graduate assistant in the TWIN-CS project, my dissertation may be of interest to program directors and design team members who are interested in learning about the state of the project and other evidence demonstrated through empirical analysis.

Chapter Summary

Current demographic trends in the United States suggest that the CLD student population is rapidly growing. Despite historically playing an important role in promoting educational opportunities, however, Catholic schools currently underserve this CLD population. Recent studies have shown that students participating in the TWI model tend to perform better academically than comparable group of CLD students not in TWI. School reform intended to serving the needs of CLD students is difficult to come by in a traditional school setting while there is a prevalence of classroom teachers practicing in isolation. TWIN-CS represents the first coordinated effort to support this school reform toward this end by promoting communities of practice in a nationwide network of primary Catholic schools. Thus the purpose of this dissertation is to understand the extent to which a relational network of educators promotes productive communities of practice.

Glossary

The following section includes brief definitions of some key terms that will be used throughout this study. Although this dissertation is a case study of a network, it employs various data collection and analyses strategies ranging from social network analysis to semi-structured interviews so providing a glossary will be helpful for the readers.

Actor: Individual entities that make up a network system. Also called a node.

Betweenness Centrality: The extent to which an actor lies along the shortest path between every other pair of actors. It is an important measure that measures an actor's ability to control the flow of communication by indexing potential for gatekeeping, brokering, and liaising different parts of a network.

Bridge/Liaison: An actor who links two or more groups in a network.

Centrality: a family of node level properties relating to the structural importance or prominence of a node in the network (Borgatti et al., 2009).

Closeness Centrality: A measure of the extent to which an actor is close to all other actors in a network. An actor with low closeness centrality measure means that the communication spreads quicker through him than another actor with lower closeness.

Cohesion: A measure of a whole network's connectedness or "knittedness" (Borgatti, Everett & Johnson, 2013, p. 150).

Communities of Practice: groups of individuals sharing a common purpose and learning to pursue this together (Wenger, 1999).

Degree Centrality: Measure of how well an actor is connected with other actors. It is measured by the sum of the connections that an actor has in a network. Degree centrality is divided into indegree and out-degrees. In-degree measures the number of ties directed to the node while outdegree measures the number of ties that the node directs to others.

Eigenvector Centrality: A measure of the extent to which an actor is connected to other wellconnected actors. High eigenvector centrality generally indicates the level of popularity in the network.

Gatekeeper: an actor who is in position to mediate or control the flow between two parts of the network.

Implementation Team: consists of TWIN-CS principals, mentors, and teachers who are involved in the two-way immersion programs within the network schools.

Isolates: are those who have no links to other actors in the network

Networks: a way of thinking about social systems that focus our attention on the relationship among the entities that make up the system, which we call actors or nodes (Borgatti, Everett & Johnson, 2013, p. 2).

Social Network Analysis: methodological examination of patterns or regularities in relationships among interacting units (Wasserman, 1994, p. 3).

Sociogram (a.k.a. network structure): A descriptive illustration of a population in terms of relations between pairs of people in that population (Rapoport & Horvath, 1961); often illustrated with a set of nodes and ties that connect the nodes to represent relationships.

Star: An actor who has high degree centrality.

Tie: characterizes relational attributes between actors. In a sociogram, this is the arrow that connects nodes, which could represent any characteristics such as if one actor seeks advice from another actor or frequency of such communication.

UCINET: A widely used software package for social network analysis developed by Steve Borgatti, Martin Everett and Lin Freeman in 2002.

Researcher's Positionality for this Study

Before proceeding to the next chapter, I use this section to briefly explain my positionality in this study and how my role in the network may affect this work as a researcher. The objective of this study is intended to conduct original research to inform educational research through the lens of CoP framework. Findings of this study is intended to provide insights for future research by presenting ways to improve collaborative learning among educators and ultimately provide feasible and effective service models for CLD students.

As a graduate research assistant for the Roche Center at Boston College, where TWIN-CS is based, I have been a part of the program since its inception in 2012. As a major stakeholder, the Roche Center has a strong interest in the results of this study, which will also serve as an evaluation report of TWIN-CS. Therefore, a part of this study's findings and implication sections will feature an internal evaluator's view with recommendations that specifically relate to TWIN-CS operations. Inevitably, my ties with TWIN-CS may warrant unintended biases and this concern is addressed at the Limitation section in Chapter 6.

Chapter 2: Review of the Literature

In this chapter, I discuss two strands of literature that contribute to this dissertation: (a) addressing the educational needs of CLD students and (b) the role of networks in education reform. I also review the literature on communities of practice as a conceptual framework for this study. In the first strand, I explore a range of bilingual service models for meeting the educational needs of CLD students. I begin this section by defining CLD and the historical context of the rise in TWI education as an effective model to address the needs of these students.

In the second strand, I examine the role of networks in education reform. As I explore the landscape of network research in education, in this section, I will discuss the interacting layers and dimensions of CoPs within the context of a network and where the current research stands in investigating such interactions.

My review of CoPs literature could be considered an attempt to understand the collaboration, knowledge sharing, capacity building, and practice improvement among educators in general. I also examine the conceptual framework of communities of practice (Lave & Wenger, 1991; Wenger, 1999) and discuss how the literature informs this study's focus on TWIs within the CoP construct.

Educational Needs of CLD Students

Defining Culturally and Linguistically Diverse Students

The population of bilingual students (students whose first language is a language other than English) in the United States continues to grow rapidly, with the population of native Spanish speakers having the largest presence (National Clearinghouse for English Language Acquisition [NCELA], 2002). "CLD student" is a frequently used term throughout this dissertation. In a general sense, CLD students are defined as those growing up in a family whose parents' or guardians' first language is a language other than English or whose family's primarily spoken language at home is not English. As the population of families with various linguistic and cultural backgrounds has grown in recent decades, terminologies that identify this category of children from such families have also evolved (Palmer & Martinez, 2013).

For much of the latter part of the 20th century, the term "limited English proficiency" (LEP) was widely used for this group of students (Palmer & Martinez, 2013). Although the phrase "culturally and linguistically diverse" has been in use since at least the early 1990s, the term "English language learner" (ELL) or simply "English learners" has been used more widely (Garcia, 1991). However, ELL itself is rather ambiguous in that it limits people to language learners, which is an insufficient way to explain and describe people. Moreover, Garcia and Kleifgen (2010) have pointed out that the use of LEP and ELL implies monolingual English speaking as the norm. To address these concerns, this dissertation uses the term "CLD students" while acknowledging both the linguistic and the cultural dimensions of diversity these students can share.

Language and culture are inevitably linked with one another. Kramsch (1998) stated that language "expresses, embodies, and symbolizes cultural reality . . . it is a system of signs that is seen as having itself a cultural value" (pp. 3–4). Language is used to reflect personal experiences, attitudes, beliefs, and points of views. It is also used to verbalize and share experiences and symbolize social groups and their identities. Classification of students' sociocultural dimensions is built on the premise that "membership in a socially defined group influences cultural practices, cognitions, motivational attributes, values and beliefs that influence the learning process"

(Goldenberg, Rueda, & August, 2008, p. 97). Thus, the term CLD has implications for those having diverse social identities, methods of communication and experiences, and shared beliefs, and such a membership may influence how they learn.

Research on the educational needs of CLD students has gained interest in recent decades (Garcia & Cuellar, 2006). The educational needs of CLD students can be examined from the perspective of the immigrant student population, of undocumented families and, more recently, of refugee families.

Some critical educational needs of immigrant students include filling in the gaps in their formal education in their native language back home, the limited capacity of school staff to educate these students, and institutional knowledge gaps on how to simultaneously build dual language as well as keep pace with the content learning for these students (Ruiz-de-Velasco & Fix, 2000). Other challenges include the different languages spoken by immigrant students originating from different parts of the world (Suarez-Orozco, Suarez-Orozco, & Todorova, 2008) and, in some cases, students being assigned to less qualified teachers, having limited access to learning resources, being isolated from their peers for remediation, and being assessed by invalid instruments that do not measure their true learning ability (Gandara et al., 2003; Vega, Lasser, & Afifi, 2015).

Undocumented immigrants are becoming more marginalized and are more likely to face hostility (Martin, Fergus, & Noguera, 2010). Students from refugee families compared to immigrant families face additional challenges of abrupt acculturation, war trauma, and interrupted educational attainment in their homeland (Hos, 2014; Kaplan et al., 2015; McBrien, 2005). Thus, the needs of these CLD students span beyond language attainment and achievement gaps to cultural and psychological barriers as well as opportunity gaps.

Additive and Subtractive Views of Bilingualism

In the early literature on language and learning, two forms of bilingual views emerged: additive and subtractive (Lambert, 1977). In his study, Lambert coined the term "additive bilingualism" to refer to a situation where bilingual learners experience the same value in learning two languages. Under the additive model, it is theorized that adding a second language to their learning repertoire should not lead to distraction or deterioration of first language competence. Lambert contrasted additive bilingualism with the term "subtractive," where the competence of an individual's heritage (or minor) language loses ground in favor of a dominant language. Another study also revealed that subtractive approaches in bilingual learning may actually lead to lower competence levels in both languages (Cummins & Swain, 1986). In general, additive bilingualism has often been associated with positive cognitive and social behaviors of bilingual learners, whereas subtractive bilingualism has been associated with negative characteristics (Cummins & Swain, 1986; Lambert, 1977).

Studies have also found the possibility of a negative impact of subtractive bilingualism on bilingual learners or bicultural individuals. In an ethnographic study of Mexican and Mexican-American students in an inner-city high school located in Houston, Texas, Valenzuela (2010) found that subtractive schooling had eliminated the social and cultural resources needed for students' academic success. A critical argument of Valenzuela (2010) was that cultural and linguistic diversity should be embraced as assets, and that schools' curricula should be developed to promote such diversity. McCarty, Watahomigie, Thi Dien, and Perez (2004) also found that for many ethnic minority groups in the United States, heritage languages are often perceived with less importance than the English language, thus allowing subtractive bilingualism to prevail. McCarty et al. (2004) argued that CLD students are at risk of diminishing their cultural and linguistic identity in traditional monolingual schooling. Zentella (1997) also stated that the problem of the subtractive form is that it views the diverse heritage language and culture as a deficit that is often substituted by English. For example, the Hispanic/Latino population in the United States originates from a variety of geographic regions with a diverse range of dialects and cultures. Rather than embracing such cultural and linguistic diversity, subtractive forms see English merely as a way of compensating for linguistic deficits (Crawford, 2004).

Additive bilingualism serves to build on a student's native language to bolster English language acquisition, enhance cultural integration, and curriculum and instructional methods that can effectively tie the linguistic development and cultural integration in classrooms (Cummins, 2000; Landry, 1987; May, 2011). CLD students in traditional school settings can benefit from this additive approach when teachers provide instructions in students' native language to aid in their English acquisition, help them develop a positive attitude toward bilingualism (Brisk et al., 2002), and address their academic challenges not just helping them acquire a second language but also by teaching new content knowledge using the students' own languages (Collier & Thomas, 2004).

Besides enhancing CLD students' academic achievements, the additive approach has also been shown to address the dimensions of cultural integration in classrooms. For example, a study of the South East Asian immigrant population in Philadelphia demonstrated that the additive bilingual approach can increase the sense of "community" among immigrant students and value learning experience in the classroom (Hornberger, 2002). Studies have also shown that schools can provide effective education to CLD students through sociocultural integration, promotion of proficiency in literacy and language attainment, and provision of high-quality curricula and instruction (Brisk, 2006; de Jong, 2011; Scanlan & Lopez, 2012). As student demographics in the United States become more diverse, providing a duallanguage immersion program for both native and nonnative English speakers in two languages offers long-term benefits in developing their positive social, cognitive, and bilingual skills (Gandara, 2010). Because of local policies, some states restrict or ban the implementation of bilingual education, which reduces CLD students' opportunities to become bilingual and expand their educational access, which further marginalizes them (Gabaldon & Ovando, 2011; Ovando, 2003).

To address these dimensions of language acquisition, cultural integration, and curriculum, TWI education has become a popular model. The TWI model is unique in that it promotes cultural value for students gaining language and literacy skills in two languages (Zentella, 1997). One primary focus of TWI is to foster additive biliteracy and bilingualism among students. Biliteracy, as defined by Pérez and Torres-Guzmán (2002), is "the acquisition and learning of the decoding and encoding of and around print using two linguistic and cultural systems in order to convey messages in a variety of contexts" (p. 60). Hornberger (1990) stated that biliteracy is "any and all instances in which communication occurs in two (or more) languages in or around written material" (p. 213).

Studies have also shown that biliteracy and bilingual education have great promise in the enhancement of linguistic benefits of student integration in classrooms (de Jong & Howard, 2009). Another study suggests that when biliteracy is fostered, "literacy skills and strategies used in one language transfer to the other" (Ernst-Slavit & Mulhern, 2003, p. 1096), which enhances students' biliteracy and bilingual abilities. These empirical findings from studies on the positive effects of biliteracy and bilingual education have allowed researchers to further their development of various curriculum models that can be tailored to specific populations' needs.

TWI is one example of such a model (Howard & Christian, 2002; de Jong, 2011; Thomas & Collier, 2012).

Defining TWI Education

The first TWI school opened in the United States in 1963 (Collier & Thomas, 2012). However, the growth of TWI programs was very slow for the next 30 years until the early 1990s, when programs began to increase at a rapid rate (see Figure 2.1). Between 1971 and 1989, only an average of 1.25 new TWI schools opened each year, whereas no new TWI schools opened between 1963 and 1970 (Center for Applied Linguistics, 2012). That trend, however, significantly increased, as 17.2 new TWI schools opened per year from 1990 through 1999, and 19.7 new TWI schools opened per year from 2000 through 2010. By the end of 2011, 422 schools across 25 states were estimated to be implementing TWI programs in their schools (Center for Applied Linguistics, 2012). Such rapid growth in the popularity of TWI programs is evidence of its apparent effectiveness in addressing the educational needs of CLD students.

Research has shown that TWI education can lead to greater academic achievement for students of both language groups (Lindholm-Leary, 2012). Students in TWI programs can develop academic skills on par with or superior to the skills of their peers in English-only classrooms (Genesee, Lindholm-Leary, Saunders & Christian, 2005; Howard, Sugarman, & Christian, 2003). Some research findings even show that bilingual students reach higher levels of academic and cognitive functioning than monolingual students or students with poor bilingual skills (Thomas & Collier, 2002). Moreover, bilingual students have skills that enable them to take advantage of more career opportunities (August & Hakuta, 1997; Callahan & Gandara, 2014).

TWI is an instructional approach that integrates native English speakers and native speakers of another language and provides instruction to both groups of students in both languages (Howard & Sugarman, 2007; Howard et al., 2003). It is an educational alternative that has the potential to be expanded even further, given the current and projected growth in the demographics and societal needs of the United States. Lindholm-Leary (2005) outlined four major goals of TWI programs: to "(1) develop high levels of oral language skills and literacy in both English and the non-English language, (2) attain academic achievement at or above grade level as measured in both languages, (3) hold positive attitudes toward school and themselves, and (4) exhibit knowledge about and positive attitude toward other cultures" (p. 56–57). Table 2.1 illustrates the four major components of TWI:



Source: Directory of Two-Way Immersion Programs in the United States. Available at http://www.cal.org/twi/directory.

Figure 2.1. Growth of TWI schools in the United States

Table 2.1

Major Components of TWI

Components
1. Instruction and classroom work takes place in two languages, with non-English language used for at least 50% of the students' instructional day.
2. A school day includes periods of instruction during which students and teachers use only one language, with no translation or language mixing allowed.
3. Both native and non-native English speakers do work in both languages in a balanced proportion.
4. Both native and non-native English speakers are together for most content instruction.
TWI programs go beyond language proficiency to enhance students' academic
confidence and broader cultural awareness (Howard et al., 2003; Lindholm-Leary & Borsato,
2001). Compared to students of traditional monolingual English instruction, students from TWI
programs tend to show stronger motivation toward academic achievement and display positive
attitudes and respect toward the other culture (usually the culture associated with the other
language in the TWI model; Cazabon, 1993; Christian, Howard, & Loeb, 2000; Lindholm-Leary,
& Borsato, 2001). Collier and Thomas (2004) suggested that "dual language education is an
inclusive model for all students and all student groups benefit from participating" (p. 18). In
addition, de Jong (2011) defined three essential goals of TWI programs for students: academic
excellence, bilingualism and biliteracy, and cultural competence.

Some studies have found that students in successful TWI programs have outscored their counterparts in state tests in English reading comprehension and mathematics (Alanis, 2000; Alanis & Rodriguez, 2008). One study found that students from one Catholic school with dual language programs had reading comprehension and mathematics scores that were nearly twice those of public school students with similar ethnic backgrounds (Scanlan & Zehrbach, 2010).

Another study found that students with balanced bilingual skills tended to have higher selfesteem and closer family ties than other students (Portes & Hao, 2002).

Successful implementation of the TWI education is critical to ensuring the quality of instructions for all participating CLD students. Montague (1997) suggested several approaches critical to success in dual-language programs: (a) gradual phasing of the dual-language model into the community, (b) provision of high-quality learning resources, (c) dedicated school leadership with solid understanding of the needs of its communities, and (d) teachers who are committed to enhancing their professional development in dual-language education. For TWIN-CS, as with any schools using dual-language programs, successful transformation and implementation of TWI models are crucial to better serving CLD students. For members of TWIN-CS learning to implement TWI at their schools, Montague's approaches present important guidelines to ensure the success of their delivery models. As noted in Chapter 1, however, the traditional instructional practices often involve teaching in isolation. Thus, an interesting research question would be if network activities within TWIN-CS advocate (or inhibit) productive learning among participants. In the following section, I will review the literature on educational reform through network practices.

Networks and Educational Reform

Reforming Educational Practice in Networks

While organizational networks or groups of schools and teachers have collaborated for professional development purposes for some time, the creation of an intentional, supportive learning community of TWI schools has been a relatively rare occurrence (HaLevi, 2011). For more than two decades, researchers resoundingly agreed that there is a prevalence of teaching in isolation among classroom teachers (Lortie, 1975; Nieto, 2003; Rasberry & Mahajan, 2008;

Sindberg, 2011), and that this practice is more pronounced in schools with new immigrant populations (Lowenhaupt & Reeves, 2015). Studies have also shown that the practice of teaching and learning is strengthened through collective questioning of ineffective teaching routines, the pursuit of new and creative ways of teaching and learning, and active engagement in supporting each other's professional growth (Darling-Hammond et al., 2009; Grossman et al., 2001; McLaughlin & Talbert, 2001; Stokes, 2001).

Over the past decade, more educational research studies examined CoPs in terms of relational networks. For example, Barab, Kling, and Gray (2004) saw CoPs as "a persistent, sustained, social network of individuals, who share and develop an overlapping knowledge base, set of beliefs, values, history, and experiences focused on a common practice and/or mutual enterprise" (p. 55). Such a definition implies a relational and social purpose among individuals bound by shared values and common practices in the pursuit of their goal. Furthermore, the collective practice of shared values in CoPs is thought to expand individual members' knowledge and test the limits of their abilities. Being a part of this network can ultimately promote productive learning. To argue this point, Jackson (2004) stated that successful networks "share and transfer the considerable knowledge already in existence that can help children learn better. Individual schools have limited knowledge, but collectively they have almost as much as they need" (p. 181).

Examining school networks has become an important strand of research in education. The strategic evaluation of financial or organizational resources among schools (Wohlstetter, Malloy, Smith, & Hentschke, 2004) is an example of this strand. Networking across schools may also enhance organizational capacity by distributing resources across participating institutions within the network (Wohlstetter, Malloy, Chau, & Polhemus, 2003). Collaborating in a school network is also thought to generate social capital by developing effective social relationships between network participants to promote "community-based knowledge sharing" (Smith & Wohlstetter, 2001, p. 499).

Research on teachers' networks has also recently gained traction in education, especially under the premise that relational networks of teachers can influence their practice in productive ways (Coburn, Mata, & Choi, 2013). Coburn et al. found that networks are embedded within the hierarchy of district policy, which leads to their tie formation process influencing the structure of their networks and effectively reallocate resources across networks" (p. 311). Teacher networks have also been examined in the context of school districts in new immigrant destinations with a high volume of English learners. For example, one recent study employed social network analysis (SNA) to examine the teacher support infrastructure in schools and found significant variations in teachers' learning on English learner instruction methods. These methods were influenced by the infrastructure at each school (Hopkins, Lowenhaupt, & Sweet, 2015). *Network Research in Education*

Broadly, there are two key areas of network research. One approach incorporates principles of graph theory and the other draws from social science (Wasserman, 1994). The former approach is rooted in mathematics and computer science. Research and analytics in this approach are involved more with algorithmic applications and are often used for analysis in the fields of natural science and IT application in businesses such as e-commerce and social media. Meanwhile, the latter focus is primarily on conceptualizing the structure of human interactions. For the purpose of this study, I focused my discussion on social scientists' approach to network research. SNA is a way to study human relations. Freeman (2004) defined SNA in the context of social science as follows:

the structural approach that is based on the study of interactions among social actors. It is a study of links between human beings and to uncover various patterns to determine the conditions under which those patterns arise and discover their consequences. (p. 2)
TWIN-CS, as defined in this dissertation, is a network of 63 individuals across 10 schools.
Because the focus of this study is on understanding how relationships among participating members address the needs of CLD students through the promotion of productive communities of practice in implementing TWI models, employing SNA becomes an intriguing methodological option.

Although most early studies employing SNA came from the fields of sociology, political science, and economics, SNA has recently been gaining popularity in educational research (Daly, 2010). Early network research can be traced back to the educational psychologists in the 1920s (Wasserman, 1994). This early network research was launched as a result of large long-term grants offered to universities such as Yale, Columbia, and UC Berkeley to study child-welfare issues by examining children's interpersonal relationships (Renshaw, 1981). The most notable accomplishment of these early network studies involved the collection of network data by interviewing individuals and asking them to name other people of interest. For example, Almack (1922) asked a select group of children to name those they would like to invite to a party and observed the patterns of the relationships between the children and the proposed invitees (Freeman, 2004).

Examining educational problems using SNA was rare until the 1990s. In fact, administrators, teachers, and staff have long been believed to be operating independently as

individual members of isolated school communities functioning as "loosely coupled systems" (Orton & Weick, 1990; Weick, 1976). It was not until the mid-1990s to the 2000s, when the number of publications related to network analysis in education leaped from about 50 in 1995 to more than 400 in 2009 (Daly, 2010). Daly (2010) suggested that SNA provides useful frameworks and methods for education researchers to examine the extent to which information is communicated within a community, to determine who is sharing information with whom, at what frequency, and to investigate the degree of congruence or disagreement existing among members within the community. Wasserman (1994) argued that social network explanation informs relationships among units in a social science study. It operationalizes individual or organizational level relationships by providing linkage among units. Thus, SNA becomes a useful methodology to explore network of CoPs. Network analysis has also been used as an approach to understand the relationships among immigrant youths (Suarez-Orozco et al., 2008). In their study, Suarez-Orozco et al. discovered that adolescent-age immigrants often find stronger emotional and motivational support in a community where many of their peers have originated from their home countries.

Research on network analysis has recently gained popularity and is a rapidly growing topic of interest in various social science disciplines (Borgatti et al., 2009; Daly, 2010, 2012). Borgatti et al. (2009) argued that there has been an explosion of interest in network research in social sciences in the 2000s and that network analysis has yielded a unique and effective way to explain social phenomena in various social contexts.

SNA in educational research did not gain much momentum until the 2000s, when there was a big push for data use for educational improvement with the passage of major policies such as No Child Left Behind (Daly, 2012). Such a shift toward data-driven instruction and
educational reform created a high degree of accountability among individual teachers, schools, and states, whereas collecting, interpreting, analyzing, and disseminating data has become much more critical for educational leaders (Coburn, Toure, & Yamashita, 2009; Datnow & Park, 2009). Naturally, the early 2000s saw a growing trend of professional interaction among educators regarding the use of data, which became a new social process. SNA is one way of analyzing such a social process, and researchers' interest in investigating relational studies in the educational context has grown over the past decade (Daly, 2012). Teachers, for instance, can improve their instructional practice by learning from each other while also collectively benefiting from one another in implementing a program or policy in their classrooms (Coburn, 2001). Furthermore, studies have found that collective learning among teachers improves their pedagogies, which in turn improves their students' learning (Scribner, Sawyer, Watson, & Myers, 2007; McLaughlin & Talbert, 2006).

As interest has grown in SNA in education, topics of interest have also diversified, ranging from computer-supported collaborative learning in classrooms (Gomez & De La Fuente, 2008) through learning relationships among college students in STEM courses (Grunspan, Wiggins, & Goodreau, 2014) to educational reform through school networks (Smith & Wohlstetter, 2001).

The review of the literature thus far demonstrates that the growing CLD student population in the United States is being underserved by the traditional school system, either through a lack of model implementation or misalignment of the models with the target students' needs. However, there are challenges in serving the needs of CLD students through reforms in a traditional school setting. Specifically, teachers are often isolated in their classrooms because of the prevailing culture of private practice. Promoting network research in educational settings has become a growing trend along the dimensions of school, teacher, and individual educator networks. The literature clearly shows that collaborative learning in relational networks fosters knowledge sharing and improves pedagogies. However, few studies have investigated the interacting layers and dimensions of CoPs within the context of relational networks. To address these challenges, this dissertation aims to investigate the extent to which a relational network of educators promotes CoPs by asking the following three questions:

- 1. Do the organizational features of TWIN-CS facilitate productive learning among participants implementing TWI models? If so how?
- 2. What are the characteristics of relational networks among participants in TWIN-CS?
- 3. How are the individuals' roles associated with promoting a perceived productivity within communities of practice in implementing a TWI model?

Conceptual Framework

The conceptual framework of communities of practice was first developed by Lave and Wenger (1991). This framework is grounded in a sociocultural learning theory where individual people can learn more effectively through interactions and by sharing their experiences. CoPs are fundamentally relational, and learning happens through interactions among individuals by sharing and transferring knowledge (Lave & Wenger, 1991). The contents and applications of learning are interlinked (Brown, Collins, & Duguid, 1989). CoPs have been used as a framework for various forms of educational reforms and practices, including the following: how CoPs influence teacher learning in regard to teachers' instructional practices (Galluci, 2003); how teacher training in a learning community can play a role in curricular reform (Defise, 2013); instructional improvement or professional development (Little, 2002; Schlager & Fusco, 2003; Shulman & Huchings, 2004); and online knowledge management with information sharing among participants (Davenport, 2001; Hara & Hew, 2007; Talja, 2002).

Indicators of Communities of Practice

CoPs are defined as a group of people who engage in the process of collective learning by sharing a concern or passion for something they do and by learning how to do it better through regular interaction (Wenger, 1999). Individuals are thought to contribute knowledge in a community when they perceive it to enhance their reputation and when they feel embedded in their learning network (Wasko & Jaraj, 2005). Wenger (1999) argued that CoP are different from a community of interest or a geographical community because neither community has shared practices. A CoP is outlined along three indicators: mutual engagement, joint enterprise, and shared repertoire.

To illustrate these indicators, I will describe the hypothetical case of ABC primary school. ABC school serves grades K–5 in a town where Spanish-speaking immigrants from Central America have been rapidly increasing in recent years. Naturally, student demographics in ABC have shifted with the influx of Spanish-speaking students, and the school has begun to look into modifying or adapting a new instructional model. The principal, school counselor, teachers, and English as a second language instructors of ABC teamed up with a professor from a local university (who acted as the mentor) with expertise in bilingualism and biliteracy to address this challenge.

In essence, the participants are mutually engaged in a CoP that binds members into a social entity to address a common interest (first indicator, Table 2.2). The *Mutual Engagement* indicator reveals who the participants are in a CoP. Participants are engaged in a *Joint Enterprise* to provide a more serviceable instructional model to address the changing student dynamics at

ABC school (second indicator, Table 2.2). The *Joint Enterprise* points to what the participants are doing in a community of practice through contributions of their knowledge. Within this enterprise, there is a *Shared Repertoire* of various channels of information (third indicator, Table 2.2). The *Shared Repertoire* indicator looks at how the participants are doing in their CoPs. This practice may take place in the form of monthly webinars led by different members who introduce new instructional models or help develop new lesson plans for English learning students. In sum, CoPs are groups of individuals (Mutual Engagement: WHO), sharing a common purpose (Joint Enterprise: WHAT) and learning to pursue this learning together (Shared Repertoire: HOW). In the context of TWIN-CS, participants of TWIN-CS (WHO) are learning to implement TWI models (WHAT) by pursuing productive ways of communicating and sharing specific tools, routines, knowledge, or resources.

Table 2.2

Indicators	Description
Mutual Engagement <i>WHO are the participants</i>	 Sustained Relationships (harmonious or conflictual) Substantial overlap in participant's description of who belongs Mutually defining identities Certain styles recognized as displaying membership
Joint Enterprise WHAT are they doing	 Shared ways of engaging in doing things together The ability to assess the appropriateness of actions and products Knowing what others know, what they can do, and how they can contribute to an enterprise
Shared Repertoire <i>HOW they are doing it</i>	 Rapid flow of information and propagation of innovation Very quick setup of a problem to be discussed Specific tools, representations, and other artifacts Shared discourse styles and content (lore, stories, jargon)

Indicators of Communities of Practice

Note: Adapted from Wenger, 1999, p. 125 - 126

The example illustrated above highlights four dimensions of learning within CoPs: (a) positionality's influence on learning, (b) fluidity, (c) variability, and (d) nonrigidity in configuration (Scanlan et al., 2016). In CoPs, members learn and influence each other based on their positionality. The ABC case, for example, has a mix of teachers ranging from a novice teacher to a veteran teacher with decades of experience. Some teachers may have expertise in bilingual education, such as the university faculty mentor, whereas others may have certification in Spanish language instruction. Such diverse positioning of roles, experience, and training helps the members of CoP to complement one another in sharing knowledge and information to learn more about adapting the best instructional model for ABC.

This positionality is also fluid based on factors such as teacher attrition, retirement, or career change. For example, although our hypothetical CoP in the ABC school are ongoing, a novice teacher may opt to leave her school to earn a PhD in education while the principal is on the verge of retirement. The mentor could opt out of her mentor role, and ABC school could replace these members with new individuals to sustain the collaborative learning.

Learning in CoP is also variable; it can be positive and harmonious or negative and conflicting. Scanlan et al. (2016) suggested that the term "community" often carries positive connotations in that members CoP learn collectively and reflect on each other's strengths; however, participating CoP can only direct one's attention to the goal of their learning. It does not change the nature of their personal ideology or belief. Finally, CoPs do not have a rigid configuration, in that members may participate in other CoPs and may bring new knowledge that they have obtained from other practices. For example, the school counselor may engage in another learning group that focuses on early childhood development. Although the learning that takes place in the other group does not specifically focus on instructional models for immigrant

students, she may provide helpful knowledge from the perspective of cognitive or psychological development. Therefore, CoPs consist of "constellations" within organizations (Wenger, 1999), leading to transformative learning (Scanlan, 2013).

The three indicators outlined by Wenger (1999) and the four dimensions of learning by Scanlan et al. (2016) can be used to guide one's examination of learning in a network of schools implementing the TWI model. As discussed in Chapter 1, TWIN-CS is a network of Catholic elementary schools across the United States that is undergoing a transformation from traditional instruction to the TWI model. The three research questions of this study sought to examine the organizational features of the network, the characteristics of the relational networks among participants, and the association of individuals' roles in implementing a TWI model. To further understand the dynamics of learning within TWIN-CS, in the next subsection, I will discuss the classification of articulation of knowledge within CoPs.

Articulation of Knowledge Activity within CoPs

The literature reveals two fundamental activities of CoPs (Klein & Connell, 2008). The first activity is characterized by the discussion of indicators in the previous subsection, and the second activity involves the articulation of knowledge within CoPs. Table 2.3 illustrates the four classifications of CoPs (Klein, Connell, & Meyer, 2005). Klein et al.'s classification places emphasis on knowledge activity and distinguishes between stratified and egalitarian CoPs. This classification has implications for the dynamics of community knowledge in CoPs (Klein & Connell, 2008). For example, knowledge-sharing CoPs may seek to develop and maintain a more structured body of knowledge, but knowledge-nurturing CoPs would allow less structure and allow the members to freely develop, interpret, and understand the learning goals of their communities. Klein and Connell also noted that the openness of egalitarian CoP is not

necessarily preferable to relatively more conservative stratified CoPs (p. 69). As I will explain through the examples below, the classification of CoP depends upon the domain of interest and the community's learning goals.

A stratified CoP represents a more ordered flow of knowledge with less flexibility in the community structure. For example, a community of new medical school graduates entering a resident program and training to independently diagnose patients fall into the category of stratified-nurturing CoP. Clinical practice is fairly prescribed, and young doctors rely heavily from knowledge from more experienced doctors and clinical textbooks. The goal of CoP is to *nurture* young training doctors to acquire the skills and knowledge that are critical for handling patients independently.

Table 2.3

	Knowledge Activity					
Structure	Sharing	Nurturing				
Stratified	 Advanced grades share knowledge with less advanced grades Knowledge "flows" down through the community Community knowledge fairly fixed and slow to change Community knowledge tends to unitary 	 Knowledge development experiences sequentially arranged Knowledge development controlled by management of experience Community knowledge changes slowly Community knowledge develops pluralistically 				
Egalitarian	 All grades share knowledge with each other Knowledge "flows" up and down through the community Community knowledge changes quickly Community knowledge tends to pluralistic 	 Knowledge development experiences not sequentially arranged Knowledge development not controlled Community knowledge changes quickly Community knowledge develops pluralistically 				

Representation of Classification of CoPs

Source: Adapted from Klein, Connell, and Meyer (2005)

A stratified-sharing CoP is similar to a stratified-nurturing one in that the community's knowledge development is sequential, slow to change, and controlled, but the knowledge "flows" down through the community from advanced participants to less advanced ones. A good example of this could be a group of amateur sea bass fishers. Learning to fish bass in open sea would take require a learning curve and adherence to fairly fixed techniques and procedures. This knowledge "flows" down through the community by sharing the skills from advanced fishers to novice ones.

An amateur group of hiking enthusiasts may fall into egalitarian-nurturing communities of practice. This CoP is not prescribed because there is no lengthy technical training or certification needed to join the club. Moreover, knowledge development or experience is not necessarily ordered sequentially, and knowledge can develop pluralistically and change rapidly depending on the changing dynamics of how people view hiking. Egalitarian-sharing CoPs are similar to nurturing groups. Their acquisition of knowledge may need to come in sequential steps, whereas their passing of knowledge may flow up and down the experience levels.

These hypotheticals are by no means rigid examples of how CoPs are classified as different communities. Communities may adopt hybrid versions of practices based on their specific needs, group composition, and the dynamics of their relationships. Although Klein et al. (2005) suggested that most CoPs would likely not come under one classification but rather under a combination of them, many CoPs are likely to fit into one predominant category (Wenger, 2011).

In the context of this dissertation, TWIN-CS may fit into the stratified-nurturing category as the dominant category but may still display some characteristics outlined by the other three. This is because knowledge development has been developing more or less sequentially among participants. For example, members participate in webinars, which builds up their knowledge base of topics ranging from summative language assessment administration to interpretation of and informed decision-making based on data to finance and budget management. The annual Summer Academy also establishes action plans for TWI implementation in the upcoming school year. Knowledge development may or may not be controlled, but knowledge builds up at a slow pace when the whole community goes through pluralistic changes, most likely at the school level. My premises in this dissertation were tested through the administration of a network survey and individual interviews and discussed in Chapters 3, 4, and 5.

Chapter Summary

This chapter reviewed two strands of literature in addressing the educational needs of CLD students and an overview of network research in educational reform. The review of CLD students had three major components: (a) defined what CLD means in the context of this study, (b) explained the context of educational needs of CLD students, and (c) discussed the landscape of educational service models for CLD students. In the review of network research in education, I discussed broadly from the perspective of an educational reform and introduced the notion of SNA and its recent rise in popularity in educational research. The third major segment of this chapter presented a discussion of the conceptual framework of communities of practice (Lave & Winger, 1991, Wenger, 1999) and introduced the four classifications of CoP (Klein et al., 2005) to guide my examination of the dynamics of CoP in TWIN-CS. In the following chapter, I will discuss the research design and methodology involve in gathering and analyzing the data to answer the three research questions.

Chapter 3: Research Design

This study explores a relational network of teachers, administrators, and TWI implementation mentors engaged in serving the educational needs of CLD students. In this chapter, I describe the overall research design by discussing the research methodology and analytic plans. I then proceed with the following sections: methodology and procedure, participants, population and sample, data sources, analytic procedures, and chapter summary.

Methodology and Procedure

Yin (2009) defined case study research as "an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" (p. 18). Yin's definition is relevant in determining the scope of the research as he proposed case study as a valuable method to understand real-life contemporary phenomenon in depth using multiple sources of evidence. Moreover, a case study is a particularly useful methodology in exploring a unit of analysis, which can include individuals, organizations, processes, programs, neighborhoods, or institutions (Yin, 2009, p. 17).

This dissertation employed a case study methodology and drew data from three sources: archival documents, social network analysis, and semi-structured interviews. Merriam (2009) advised that a case study is a bounded system and all examinations and analyses should take place within the boundary. This boundary defines a unit of analysis, which characterizes a case study, and all observation and analysis must take place within this unit of analysis (Stake, 2005; Merriam, 2009).

Yin (2009) proposes that case studies contain five components of research design: (1) study questions, (2) research propositions, (3) unit(s) of analysis, (4) logical linking of the data to

the propositions (or underlying assumptions), and (5) criteria for interpreting the findings. Discussions of these five components in the context of this study will follow throughout this chapter.

Study questions and theoretical assumptions

In Chapter 1, I discussed the three research questions that guide this dissertation. Although propositions are not required for all case study research, particularly in exploratory case studies, having propositions or at least theoretical assumptions will guide the researcher to move in the right direction (Yin, 2009). Yin also suggested that research questions address what needs to be answered but they do not point to what should be investigated in answering these questions (p. 28). Theoretical assumptions are helpful in this regard by directing researchers' attention by offering the scope of the study and what should be examined. These assumptions also reflect upon theoretical issues (frameworks) and offer guidance as to where to look for relevant evidence and data to answer the research questions.

Table 3.1

Research Questions	Theoretical Assumptions
Q1: Do the organizational features of	Due to intentional formulation of a relational network,
TWIN-CS facilitate productive learning	TWIN-CS members sustain relationship by engaging
among participants implementing TWI models? If so how?	and learning to understand TWI model implementation
Q2: What are the characteristics of	A. Members of TWIN-CS collaborate to mutually
relational networks among participants in	benefit in learning to implement TWI in their schools
TWIN-CS?	B. Some members within this CoP influence learning
	more than others
Q3: How are the individuals' roles	C. Learning in TWIN-CS is not always constructive
associated with promoting a perceived	D. Individual knowledge source is not confined to
practice in implementing a TWI model?	TWIN-CS

Research Questions and Assumptions

Hence, I included the research assumptions that provide some degree of underlying rationale and direction this study followed in answering the research questions. Table 3.1 highlights this study's three research questions with their underlying assumptions.

Participants

Unit of analysis

Although there are many ways of defining units of analysis, the most obvious examples are "Those in which the boundaries have common sense obviousness, e.g. an individual teacher, a single school, or perhaps an innovating programme" (Adelman, Jenkins & Kemmis, 1983, p.3). All three research questions of this study are bounded by the TWIN-CS and the underlying propositions provide rationales that specifically relate to how the participants of TWIN-CS engage in learning to implement a TWI model. Therefore, the unit of analysis for this study is TWIN-CS.

One major reason for employing a case study methodology for this dissertation is because the bounds of TWIN-CS are clear. For the purpose of this research, TWIN-CS as a unit of analysis consists of the implementation team members of the ten network schools and the TWIN design team members at Boston College. For each network school, the implementation team is composed of its principal, teachers who have taught in a TWI classroom during the 2014-2015 academic year, teachers who have been preparing to teach in a TWI classroom beginning 2015-2016 academic year, and a TWI mentor. The TWI mentor is an expert of dual-language instruction models who has contracted to provide coaching and mentoring for her school in transitioning from monolingual education to implementing a TWI model. These mentors are usually university professors specializing in bilingual and biliteracy education.

The TWIN design team consists of Boston College faculty with research expertise in

educational leadership, Catholic education, bilingualism and biliteracy as well as senior staff members at the Roche Center for Catholic Education at Boston College. The TWIN design team members are primarily responsible for outlining and implementing a research agenda. They also provide consultations to implementation teams in the areas of summative and formative assessments, data interpretation and literacy, and sharing research implications from ongoing research. Further details will be discussed in the results section of Chapter 4. The TWIN design team members are primarily responsible for planning professional development content such as the biweekly webinars, annual Summer Academy, and handling all administrative and logistic communication with the implementation teams.

Population & Sample

Unlike many business organizations, where professional networks and communities of practice do not fundamentally change the nature of the business, educator CoPs are more about transforming their learning theory and practices, ultimately serving the learning needs of their students (Wenger, 2011). Although there has been increased interest in peer-to-peer professional development, knowledge sharing, and providing access to isolated teaching practices through relational networks of educators, scholarly examination of CoPs in the context of learning transformation is scarce (Daly, 2012; Wenger, 2011; Chi-keung, 2009). Therefore, implications of the findings from this dissertation will be of interest to teachers and administrators who are engaging in CoPs designed to serve the learning needs of CLD students.

Broadly speaking, sampling is divided into two types: probability and nonprobability (Merriam, 2009). Probability sampling is commonly used in quantitative research where various versions of random sampling (simple, stratified, etc.) are taken from the target research population. Assuming that probability sampling is done properly, results and findings from the

sample can be generalized to the population and discussions about the implications may occur with statistical and measurement error taken into consideration. Findings from nonprobability sampling, on the other hand, cannot be tied to a well-defined population. Since the goal of qualitative case studies is not to generalize in a statistical sense, nonprobability sampling is often used for qualitative research.

Patton (2002) uses the term "purposeful" for nonprobability sampling. Purposeful sampling is based on some assumption or proposition that drives a qualitative study and the researcher, by choice, selects a group of individuals or groups who will likely provide the most relevant information to gain insight to answer the research questions. Patton (2002) also argues that "the logic and power of purposeful sampling lies in selecting information-rich cases for study in depth. Information-rich cases are those from which one can learn a great deal about issues of central importance to the purpose of the inquiry, thus the term purposeful sampling" (p. 230) and he proposes 16 types of purposeful sampling, each with different purposes. Table 3.2 highlights select sampling types and their relevance to research and evaluation methods.

Survey Respondent Selection. In the *Participant* section, I defined the unit of analysis as TWIN-CS and specifically targeted the implementation team members of the ten network schools along with the TWIN design team from Boston College. Since this research has a clearly defined unit of analysis (TWIN-CS) with specific criteria for sample selection (implementation team & TWIN design team), the sampling methodology will then follow Patton's *criterion purposeful* sampling (see Table 3.2). The sample of interest in this dissertation consists of 39 teachers, 10 principals, 10 mentors, and all four members of the TWIN design team, totaling 63 possible respondents. This *criterion purposeful* sampling is important for addressing the objective of this study for three reasons: First, the sampled participants are actively engaged in

transforming their instruction from the traditional English-only model to a TWI model. Secondly, they have a shared domain of interest in serving the educational needs of CLD students through the use of TWI model. Lastly, they are collectively developing a shared repertoire of resources and knowledge, including discussion of their experiences, learning tools, and ways to address challenges in meeting their common domain.

Interviewee Selection. Interviewee selection also followed the guidelines of purposeful sampling methodology. Among the 16 types proposed (Patton, 2002), I based my selection on a combination of *Criterion* and *Opportunistic or Emergent purposeful sampling* (see Table 3.2). From June 19th through the 26th of 2015, TWIN-CS congregated in Lenox, MA for its 3rd annual Summer Academy so I seized the opportunity to interview 13 individuals.

Prior to the Academy, I conducted a brief analysis of the network data gathered in May to generate a sociogram of the TWIN network structure. Based on the response patterns from the interim survey analysis, I selected interviewees along three criteria. First, the emerging patterns of actor roles such as a liaising or gatekeeping were noted. In addition, actors that have very little connectivity or in isolation were also considered for interviews. Second, teachers had top priority in interview recruitment. This is because summer break began immediately after the Academy and – traditionally from previous Academies – teachers are more difficult to reach during the break than principals or mentors. Third, I had planned to interviews and three each for mentors and principals. The Academy has a rigorous schedule from early morning until the evening hours and the only realistic times for interviews are either during breakfast time or break before the evening social hours and 12 would be a realistic goal. The reason for selecting 6 of 12 interviewees as teachers is because they comprise a little over half of the network.

Table 3.2

Select Types of Purposeful Sampling

Types	Common Usage
Extreme or Deviant	• Used to examine how a program will function in highly unusual manifestations of phenomenon of interest
Case	• Cases with outstanding successes, notable failures, highly unusual events
Intensity	• For cases with rich information that manifest the phenomenon of interact but not highly unusual agong
Intensity	• Cases with above or below average performance
	Intentionally selecting a wide variety of dimensions of interest
Maximum Variation	 Heterogenity of participants; different nationalities, professional backgrounds, cultures
	• Based on logical generalization, such as if true in this case, it is likely true in other cases
Critical Case	• To help stakeholders to make informed decision on the efficacy of an educational program
Criterion Purposeful	• Establish a criteria and select all cases that meet that criteria; very strong in quality assurance
Theory-Based or Operational Construct	• Finding manifestations of a theoretical construct of interest so as to elaborate and examine the construct
Confirming and Disconfirming cases	• Seeking further information of emerging issues in an ongoing study
Stratified Purposeful	• To illustrate the characteristics of specific subgroups or clusters of interest and to observe the different clusters
	• Cases involving nesting and clustering by subgroups
Opportunistic or Emergent	• Adds sample following new leads after fieldwork has already begun to take advantage of the unexpected flexibility
Random Purposeful	 Random selection within a purposeful case or categories of a case When the purposeful sample is larger than one can handle
Sampling Politically Important Cases	• Selection of politically sensitive (or sometimes avoiding) unit of analysis
Convenience	 Purely based on the convenience of access or cost Least desired and lowest credibility
Combination or Mixed	 Combines various sampling types to achieve the desired sample Helps in triangulation, allows for flexibility, and meets multiple interests

Lastly, I interviewed two design team members shortly after the Academy since I had

access to have one-on-one meetings on campus post-Academy with them. Although the interviewee selection process is solely purposeful and non-probabilistic, the current selection plan will have interviewed nearly a quarter of the entire network with fairly close representation of the proportion of each of the four roles (principal, mentor, teacher, design team).

Based on these criteria, I managed to interview 13 individuals at the Academy in June of 2015 and the design team members at the end of summer. The general breakdown of the interviewee profile is: 4 principals (50% of all principals), 4 mentors (40%), 5 teachers (15%), and 2 design team members (50%). In terms of the interview process, 11 of 13 interviews proceeded individually, while one interview was conducted with two mentors simultaneously and another interview with two teachers simultaneously. The two teachers are affiliated with different schools. In all, 11 unique interview sessions took place at the 2015 Academy.

Time constraint was the main reason some interviews took place in pairs. As discussed, the Academy had an intense schedule that lasted from early morning to evening hours each day. In hopes of interviewing as many at the Academy, I modified the criteria to conduct two interview sessions with two individuals simultaneously. The revised criteria featured: (1) no more than two individuals per interview, (2) each interviewee pair should have the same role (i.e. a mentor paired with another mentor), (3) the individuals agree to an interview with another person in the same session, and (4) advise these paired-interviewees to respond based on their own recollection or experience. In practice, this slight modification in the interview process was a combination of convenience and criteria purposeful sampling. Chapter 4 provides an in-depth analysis of the interviews and discuss how the response implications may or may not have been altered due to pairing effects.

Research Setting. The ten network schools span across the country. They are located in: Greater Los Angeles, Greater Seattle, Boise, Milwaukee, Phoenix, Minneapolis, Baltimore, New York City and two schools in San Antonio. With the exception of one school, which has operated a stand-alone TWI program since 2010, seven of the other nine schools began implementing their TWI models starting fall 2013 and two schools began in fall 2014.

Since TWIN-CS covers a wide geographic territory, the research setting thus far has been through two means: a virtual interface and the annual Summer Academy. First, the virtual interface has allowed the TWIN participants to interact and communicate via webinars, teleconference calls, emails, and responding to online surveys. I have documented the participants' virtual activities and will observe and analyze data generated through this source for this study. Secondly, the annual Summer Academy has taken place in June since 2013. It provides an intensive weeklong retreat for the entire network as they travel to a designated location in Massachusetts to attend informative workshops, participate in discussion sessions, recollect on the previous year and lay out a framework for the upcoming school year. The Summer Academy is a great opportunity for the network members to meet and promote knowledge sharing and learning from one another on learning to implement the TWI models in their schools.

Data Sources

Archival Data

As discussed, the first research question explores the organizational features of TWIN-CS affecting collective learning about TWI among participants. The data come from archived interpersonal communications, field notes, and post professional development evaluation reports. Interpersonal communications include postings amongst TWIN-CS members via virtual online community (TWIN website), biweekly professional development webinars participations, and email communications. I have also documented field notes in the form of meeting minutes and teleconference communications. The post professional development evaluations reports were distributed to all participants after the annual TWIN-CS Summer Academy (2013 and 2014) and NCEA Conference (2013 and 2014) and qualitative information has been documented and archived for analysis.

Social Network Survey

The second data source was collected following the social network analysis methodology. As part of the research efforts at the Roche Center for Catholic Education at Boston College, a survey was developed and administered to the ten TWIN-CS schools in January of 2014 and again in June of 2014. The TWIN design team gathered the data via this survey modified from an established tool used to explore the emergence of relational networks forming CoPs (Scanlan, 2014). This survey served as a pilot for this dissertation as modifications were made to focus more on answering the second research question. For the purpose of this dissertation, I refined this survey into a whole network survey (Borgatti, Everett & Johnson, 2013) and asked teachers, principals, mentors and the design team to identify other individuals whom they communicate with about learning to implement TWI models. Data from this survey will quantify the strength of the relationship, frequency of communication, centrality and cohesion measures among participants of TWIN-CS.

The mode of data collection is the Qualtrics online survey tool (Qualtrics, Provo, UT, 2015). Participants received an "invite to participate" email with the survey link directly embedded in the email. Respondents were allowed to use a device of their choice (laptop, desktop PC, tablet, smartphone, etc.) and respond in any location where they have access to the Internet. Each

respondent has provided his or her contact information to the TWIN-CS research initiative when their schools first joined the network. I anticipated about 15 minutes for each respondent to complete his or her survey.

Survey Structure. The survey is divided into three major components: background demographics, relational network, and characterizing the communication channels. The first section of this survey collects traditional demographic information from the respondents. Demographic data provide characteristics of this study's population and, as with any empirical research study, the survey data can be segmented into meaningful groups of respondents based on demographic considerations (Axinn, Link & Groves, 2009). Each node represented in the network survey has characteristics, which are typically called "attributes", that distinguish one another and these attributes are represented as ties or links between the nodes in a sociogram (Borgatti, Everett & Johnson, 2013).

Network analysis is particularly useful in capturing and explaining how behaviors, locally embedded in social structures, vary across individuals (Hanneman & Riddle, 2005). Participants of TWIN-CS represent the research population and since the second research question concerns interpersonal connectivity and the importance of participants' roles; network analysis becomes a strong analytic option.

I designed this survey to answer the second and third research questions. The second question looks to illustrate the individual participants' relational characteristics within the network while the last question examines the association of individual members' perceived productivity in CoPs. There are two major organizational characteristics of TWIN-CS: school affiliation and job title. In all, 10 schools made up the network and this question is the very first item on the survey (see Figure 3.1). The next item on the survey has the respondent choose their

job title within the network (see Figure 3.2). Based on their job title response, respondents were directed to different items specific to their roles. For example, a principal was asked whether she has teaching obligations in addition to her administrative leadership, which is relatively common in Catholic primary schools. Other background characteristics are detailed in Table 3.3.

lease select your school affiliation from	the drop-down menu:
All Souls	Click here to edit choices
All Souls	
Archbishop Borders	
Boston College Roche Design Team	
Juan Diego Academy Holy Rosary	
Notre Dame Priman	
Risen Christ	
St. Leo the Great	
St. Mary Magdalen	
St. Mary's	
St. Matthew	
Teacher / Faculty	
Mentor	
BC Roche Design Team	
Other: (specify)	
11	

Figure 3.1. Illustration of Network School Selection

Please indicate your role:

- O Principal / Headmaster / President
- O Teacher / Faculty
- Mentor
- O BC Roche Design Team
- O Other: (specify)

Figure 3.2. Illustration of Job Title Selection within TWIN-CS

Table 3.3

Other Demographic Variables

	Variables	Demographics
1	Gender	Female Male
2	Educational attainment	High school and/or some college courses Associate's degree Bachelor's degree Master's degree Doctoral degree or equivalent
3	Part-time / Full-time status	Full-time Part-time
4	Teaching obligation as a principal	Full-time without teaching obligation Full-time with teaching obligations Part-time without teaching obligations Part-time with teaching obligations
5	Grade level teaching	Pre-K Kindergarten 1st grade 2nd grade 3rd grade 4th grade 5th grade Other: please specify
6	Bilingual education training program/certification status	Yes (1) No (2) Other: Please specify your circumstances:
7	Years of total teaching experience	Year(s) working as a teacher in TOTAL Year(s) working as a teacher at your CURRENT school Year(s) working as a teacher in a BILINGUAL program
8	Years of teaching in a bilingual education setting	Year(s) working as a principal in TOTAL Year(s) working as a principal at your CURRENT school Year(s) working as a principal in a BILINGUAL program
9	Years taught in the currently affiliated TWIN school	Year(s) working as a mentor for your CURRENT school Year(s) working as an academic or professional for a BILINGUAL program

As shown on Table 3.3, the vast majority of the survey respondents were women (81%). Master's degree was the most common level of educational attainment with 45% of the respondents holding some form master's degree. Other degrees included 33% bachelor's and 22% doctorate degrees. Of the eight principals who have participated in the survey, two had teaching obligations and reported teaching at least one class throughout the school year. Bilingual certification status was roughly equivalent as 45% of the respondents had formal bilingual certification while 41% did not. Six respondents (14%) reported that they were either working towards earning a certificate at the time of their survey submission or had taken some higher education courses related to bilingual education or ESL programs. Average length of total teaching years was slightly above 11 years ($\bar{X} = 11.2$), while average length of teaching in a bilingual setting was less than half ($\bar{X} = 5.1$) of the total teaching average. The interquartile ranges (range between 25th and 75th percentiles) for the total teaching and bilingual education experience were (5.5, 14.0) and (2.3, 6.5), respectively.

The second section of this survey collected relational network data. The purpose of relational data is to help understand the network's organizational features and how its members interact and communicate with each other in learning to implement TWI models. A relational network data collection essentially can be applied in one of two ways: (a) a name generator, which requires identifying specific names or (b) a resource generator, which may use roles or titles rather than names (Borgatti, Everett & Johnson, 2013).

For this dissertation, I used name generation for the following reasons. First, the network schools are small Catholic primary schools where many participants engage in more than one specific role. For example, in some schools, the principal is also a teacher. Secondly, identifying the role or title does not provide the full level of information needed to answer the research

question in that resource generation will not allow full two-way interactions between actors. For example, there are several teachers in each network school. If a teacher in school A indicates that she seeks advice from a teacher in school B and vice versa, there's no way of knowing if these two teachers from schools A and B are directly communicating with each other or if there is some other teacher involved in the communication channel. This is because they are identifying a role that has multiple people (especially in case of teachers) in each school as opposed to a specific individual. Thus we lose rich data illustrating the interaction among teachers in the network without the use of a name generation methodology.

A name generator can take on the form of an open-ended form vs. a closed-ended form. In an open-ended form, respondents are asked a relational question and answer by naming individuals within the network. For example, a network question may ask "during the past school year, to whom did you talk to about implementing a TWI model in TWIN-CS?" and the respondent will literally list all the names that comes to mind. A closed-ended form, on the other hand, has a predetermined roster of all participants in a network and respondents are to select the names from this roster that answers the survey question.

When the conditions are met, a closed-ended format has more benefits than an openended format. To use a closed-ended format, the set of nodes comprising the network must be selected and defined in advance and the network size should be reasonably small to avoid a roster that continues on pages after pages. The greatest advantage of a closed-ended format is that it reduces the chance of respondents' recollection error. A relational network study of the crews working at the South Pole station, which had a small size ranging from 22 to 28 over a three-year period, found that respondents would forget to mention about 25% of their team members in an open-ended format questionnaire (Borgatti, Everett & Johnson, 2013). Moreover, providing a roster effectively reduces respondents' response time by clicking on specific names as opposed to thinking through and writing out the names. Because this study has a clearly defined network of relatively small number of participants (n=63) and since most have either met or interacted through various channels, such as the Academy or webinars, I chose to use the closed-ended format for the relational network survey (see Figure 3.3).

Q2.14 During the past school year (2014-2015), who (if anyone) did you talk to about implementing the TWI model? (*Note that the list below is anonymized. The actual survey included real names of the participants and their roles)

School A

- Principal (13)
- O Mentor (14)
- O Teacher 1 (15)
- **O** Teacher 2 (16)
- **O** Teacher 3 (17)
- **O** Teacher 4 (18)
- **O** Teacher 5 (19)

School B

- Principal (14)
- O Mentor (15)
- **O** Teacher 1 (16)
- **O** Teacher 2 (17)
- **O** Teacher 3 (18)

Boston College Design Team O Design Team 1 (14)

Figure 3.3. Illustration of Closed-ended Roster

After the full roster is provided, respondents were then asked to respond to two relational network questions. One question asked to whom they *ask specific questions* about implementing a TWI model and the other question asks to whom they *seek general advice* about implementing a TWI model. In addition, respondents were asked about the frequency of their communication in a five-point ordinal scale. Lastly, a nominal categorical question asks the kind of things they talk about in their interactions (see Figure 3.4). Using Qualtrics, I programed the survey in a way such that only those selected from the roster will appear in the network questions, frequency, and communication topics related to their interaction. As shown in Figure 3.4, Qualtrics generates a list of names in the first column "Names Listed" based on who the respondent has selected from the roster. For example, if a respondent chose five names from the roster, each of these tables will have five rows, each represented by the selected names from the roster.

How often do you talk to the	following colleagues about i	implementing the TWI model?
------------------------------	------------------------------	-----------------------------

Names Listed	Less than once per semester (1)	Once or twice per semester (2)	Once or twice per month (3)	Once or twice per week (4)	More than twice per week (5)
	0	0	0	0	0

With which staff members do you... [Check all that apply]

Names Listed	Ask specific questions about implementing a TWI model (1)	Seek general advice about implementing a TWI model (2)
	0	0

What kinds of things do you talk about? [Check all that apply]

Names Listed	Teaching challenges in TWI setting	Developing a TWI curriculum	Sharing instructional materials & strategies	Coordinating instruction with one another	Multicultural interaction in classroom	Reference to other resources I can reach out for help	Summative & formative assessment
	0	0	0	0	0	0	0

Figure 3.4. Network Question, Frequency and Communication Topics

The final section of the survey contains items that ask respondents to characterize the strength of the relationships and collaboration within their schools and across the network in a four-point ordinal scale (minimal, fair, good, strong) and to explain the primary reason for talking to some people (and not talking to) in learning to implement TWI model.

Response Rate. Because this dissertation is a whole network case study of TWIN-CS, a low response rate becomes a validity concern. As discussed, a case study observes, analyzes, and finds implications in a defined unit of analysis so as much of the participants' behavior or practices, within the defined unit, related to the research questions should be documented. Ideally, and given that unit of analysis is a purposefully selected set of individuals (N=63), a perfect 100% response rate to the network survey will provide a complete empirical evidence.

In reality, however, a perfect response rate is highly unlikely for three reasons. First, due to the nature of a network survey, the respondents had to disclose their identity and mention specific individual names in order to gather data about the communication channel within the network that will help answer the research questions. Although network survey items only focus on respondents' "learning to implement TWI through network interaction", I expected some respondents to feel uncomfortable about this non-anonymity and may opt out from filling out the survey. Moreover, due to ethics and IRB protocols, I could not force any respondent to complete the survey. Secondly, the timing of this survey release, towards the end of the school year, was one of the busiest times of the year for teachers and principals, which may have led this survey to be on the low end of their priority list. Long backlogs of IRB requests and refining the issues of anonymity in the network survey extended the IRB process from the originally planned release date. Lastly, because TWIN-CS is a research initiative, respondents were prone to many other

surveys or data inquiries from the Boston College design team which may lead to a fatigue factor.

Attaining reasonable survey response rates in academic studies has long been a challenge to many researchers (Baruch & Holtom, 2008). While different studies suggest reasonable response rates (Baruch 1999; Roth & BeVier, 1998), the general consensus for the whole network survey ranges between 75%~90% to be considered an adequate response rate (Kossinets, 2006; Žnidaršič, Ferligoj & Doreian, 2012). The suggested minimum rates from the literature are rather ambitious and necessitated some careful strategies to improve responses.

Improving Response Rate Strategy. Studies have shown that researchers can use strategies to increase survey response rates (Bennett, Nair, & Wayland, 2006; Nair, Adams & Mertova, 2008). Some strategies include:

- Notifying respondents of the upcoming survey ahead of time
- Sending reminder emails throughout the survey period
- Personal contact with non-respondents to assure them of the importance of their participation in the survey
- Provide motivation or incentive to complete the questionnaire
- Provide discussion or endorsement about the survey whenever possible

In an effort to obtain a high response rate, I employed several of the suggested strategies in literature and tailored them to the organizational status of TWIN-CS. The strategies are as follows in sequential order:

 A senior member of the Boston College design team sent out a "heads-up" email to all 63 respondents a five days before the survey was released explaining the importance of this survey and appreciating their full attention

- 2. The survey email and message was sent under the principal investigator of the TWIN-CS research title to show support and endorsement for this study
- 3. Respondents who submitted the survey were automatically enrolled into a raffle drawing to win either a \$25 Staples or \$50 Amazon gift card
- 4. I sent two reminder emails, each one week apart after the first distribution date, to those who had not submitted the survey.

During the survey data collection stage, I learned that two of the ten schools had encountered what one of the design team member phrased as "profound internal challenges" that impeded implementation team members from these schools to participate. After discussing this issue with my committee, I decided not to count the implementation members in these two schools from the survey sample. This modified the original survey participant size from n=63 to n=56. In all, 42 out of 56 responded to the survey yielding a 75% response rate. Breakdown of the response rates by roles are 100% for the principals (n=8), mentors (n=10), BC design team (n=4) and just 59% for teachers (20 of 34). Possible issues and challenges surrounding low teacher participation in the network were addressed during the interviews, which took place a month after the survey closed. Specific results of these findings, as well as implications of missing data in the network survey will be discussed further in Chapter 4.

Semi-structured Interviews

The final data source consists of semi-structured interviews (Drever, 1995). Interview methods provide rich qualitative data to explain why and how certain individuals are more engaged in promoting CoPs within TWIN-CS while others are less engaged. While the network survey illustrates the relationship among members in the network and quantifies the strength of those connections, interviews probe further into providing qualitative details of the relationships.

I hypothesized a strong degree of dependence to the Boston College design team among individuals within the network. Results from the network survey may support (or reject) this proposition by quantifying the strong relationship of the individual respondents and illustrating their ties in the sociogram. Interview data are a great source to expand the understanding of how teachers, principals, mentors, and design team members think about high dependence on the design team and to draw some critical thoughts on how the communication channels can be modified to mitigate such phenomenon.

A semi-structured interview approach is the most appropriate qualitative method in this dissertation for a couple of reasons. First, it provides some structure to supplement key insights from the first two research questions with in-depth qualitative details. Secondly, it ensures flexibility in what sequence questions are asked, and whether and how particular areas might be followed up and developed with different interviewees. This allows interviews to be shaped by the interviewee's own understandings and complements the quantitative network survey data.

Table 3.4

	Archival	Network	
Research Questions	Documents	Analysis	Interviews
Q1: Do the organizational features of TWIN-CS facilitate productive learning among participants implementing TWI models? If so how?	0		0
Q2: What are the characteristics of relational networks among participants in TWIN-CS?	0	0	
Q3: How are the individuals' roles associated with promoting a perceived productivity within communities of practice in implementing a TWI model?		0	0

Relationship between Research Questions and Data Sources

Table 3.5

Timeline of Data Collection

Months	October 2013 through February 2015	2015 March	April	Мау	June	July/August
Archival (evaluations, webinars)						≽
Network Survey (Qualtrics online)		Develop Instrument	→ File IRB ·	> Admir Survey	$\rightarrow \gamma$	
Interviews (~30 minutes)			Devel Proto	lop ———— Icol	>	Conduct —> Interviews

Interview Protocol. The goals for the interviews are to answer the first and third research questions. The protocol is divided into two components. The first component addresses all respondents and the second component has specific questions for each of the four roles in the network (principal, mentor, teacher, design team). For the most part, I planned to conduct a non-sequential/parallel analysis design for my quantitative and qualitative data. However, the network survey did have some influence on developing the protocol and interviewer selection. For example, I wrote the two teacher specific interview questions based on the low teacher participation rate in the survey and their peripheral presence in the network sociogram. I asked open-ended questions so that the respondents could narrate relevant stories about their thoughts and conditions. The teacher specific questions asked: "Can you tell me a story about some challenges you face as a teacher in being an active member of TWIN-CS?" and "How do you think the teachers can get more involved in collaborative learning among all TWIN-CS members to help address your concerns?"

Questions in the general component ask interviewees to characterize the overall progression of TWIN-CS as a whole network as well as their views on the productivity of interactions among individuals. Based on the initial responses, I probed for additional details by asking specific examples and critical elements learned through these interactions.

The role component focuses on the challenges they see from their specific role in the network and I probed for their vision for improvement in the future. For example, the nature of challenges that the teachers face may be different from what the principals or mentors experience in the network. Conversations with different individuals across roles provided narrative details about the status of their engagement in the network and their perception on how it can be improved.

In designing the interview protocol, there are several types of desirable questions and a few types that should be avoided. Merriam (2009) suggested that interview questions should be open-ended and allow the interviewee to provide descriptive information. Some common examples could ask interviewees to describe the ideal situation in the case study or explain how they would interpret certain phenomenon or practices. On the other hand, some questions to avoid in an interview are: asking multiple questions in a single item, questions that may lead towards an assumption or biased opinion, and closed-ended questions that can be answered with a simple yes or no response (Merriam, 2009). In sum, interview protocols should allow the interviewee to tell a story and describe their thoughts, observations, and understanding without leading them to biased perceptions or opinions. It should be written in a clear and succinct way such that the interviewee will not be confused about the objective of a question.

Prior to the start of each interview, I asked for their permission to audio record the interview and take field notes during the interviews. All interviewees consented for audio recordings prior to their interview sessions. The full interview protocol is provided in Appendix B.

Analytic Process

Quantitative Analysis Procedure

The second analytic process involves a feature of social network analysis called "whole network" analysis. Since this study builds on a case study of TWIN-CS as the unit of analysis, it makes sense to survey the whole network to understand the relationships of the participants. I developed a network survey instrument during the early spring of 2015 and submitted it for IRB approval on April 15th. IRB approved the survey in late May, and the survey was sent out to all 63 respondents following the protocol discussed above.

Survey Data Preparation. I used a combination of SPSS 22, UCINET 6 (Borgatti, Everett & Freeman, 2002) and NetDraw (Borgatti, 2002) network visualization tool to analyze the network survey data. Qualtrics provides an easy option to export SPSS data files which can be used to obtain descriptive statistical outputs on the demographic and attribute data. This was particularly useful for analyzing sections 1 and 3 of the network survey. Network data files must be structured in a certain way for UCINET and NetDraw to analyze and visualize the information. Qualtrics can export the survey data in a list format into an SPSS data file. That is, each row in the SPSS represents an actor while the columns represent the survey items and their response options. In order to generate a sociogram and analyze network data in UCINET, this list format must be transformed into a matrix format. Response patterns may not be symmetric in that A can ask B questions about TWI but B may not necessarily ask questions to A. Table 3.6 shows a simplified example of a matrix that can be used in UCINET.

Table 3.6

	John	Becky	Abbey	Sam	Mike	Sarah
John	0	1	0	1	0	0
Becky	0	0	1	1	1	0
Abbey	0	1	0	1	0	1
Sam	1	1	0	0	0	1
Mike	0	0	0	1	0	0
Sarah	0	0	0	1	1	0

Matrix Table for UCINET Analysis

In the example above, you will notice that the matrix is not symmetric and "1" represents communication and "0" represents no communication. To read this table, you would

go from the names on the rows to the columns. For example, John asks Becky and Sam specific questions about TWI models and Becky asks Abbey, Sam and Mike questions. Notice that John asks questions to Becky but she does not ask John any questions related to TWI implementation. This matrix data can be imported into the UCINET in one of two ways. One way is to prepare the data in excel or csv format and import it directly from UCINET. Another option is to manually type in this table in the spreadsheet interface provided within UCINET.



Figure 3.5. Sociogram of the TWI Question Network Sample

Network analysis can be illustrated via sociograms and I used NetDraw to generate all sociogram visualizations. NetDraw is a tool that is used in conjunction with UCINET and it feeds UCINET data files directly to generate sociograms. A sociogram representation of the data matrix in Table 3.6 is shown in Figure 3.5. Notice that Sam has a high "in-degree" as all five other nodes ask him for questions related to TWI model implementation, which makes him a "star" node in this network. John, on the other hand has the least number of ties as he only has

interacted with Becky and Sam.

There are a few terms that are commonly used in analyzing and interpreting sociograms. A "path" in the context of network analysis is a unique sequence of ties that *does not* revisit a node. For example, one path in Figure 3.5 is John \rightarrow Becky \rightarrow Abbey \rightarrow Sam. A shorter path is John \rightarrow Becky \rightarrow Sam. A "trail" is when a node can be revisited but *no ties overlap*. An example from Figure 3.5 is Becky \rightarrow Sam \rightarrow John \rightarrow Becky \rightarrow Abbey. Lastly, a "walk" could be any sequence of nodes that are tied, without overlap restrictions. John \rightarrow Becky \rightarrow Sam \rightarrow John \rightarrow Becky \rightarrow Abbey is an example. The "length" of walks, trails, and paths are counted by the total number of links defined in each sequence and the shortest length in any sequence is called a "geodesic." (Borgatti, Everett & Johnson, 2013).

So why do paths, trails, and walks matter? These allow researchers to model different analytical procedures based on their research objectives. For example, an epidemiologist studying an Ebola outbreak wants to know how quickly he can identify the disease spread and break the tie. An infected person who spreads it to another person would not spread the same virus to that same person, so it will probably spread in a restricted "path." In a TWI question network, however, information can traverse unilaterally and an individual can ask the same person repeated questions, and vice versa.

Centrality Measures. One critical concept of network analysis is "centrality". Centrality quantifies each node in a network and measures centrality scale in terms of its structural importance (Borgatti, Everett, & Johnson, 2013). Centrality has several measurement components: degree, closeness, betweenness and eigenvectors. Essentially, the degree centrality looks at how many connections an actor has represented in terms of ties with the node with other nodes in the network. Since what we are dealing with here is a directed network, out-degree is
the count of outgoing ties whereas in-degree is the count of the number of incoming ties to a node. Degrees can be interpreted in different ways based on how the relational questions are asked. For instance, in our TWI question network we may interpret a person with high outdegree as being "inquisitive" or "engaged" or "active learner of TWI models" while someone with high in-degree may be interpreted as "advice givers" or "TWI content experts".

The closeness centrality is based on the length of the average shortest path between an actor and all other actors in the network diagram. Freeman (1979) defined closeness centrality as the sum of geodesic distances from one node to all other nodes in a network. Therefore, an actor with high closeness centrality measure is *farther* to more actors than any other actor in the network. Since closeness measures relative geodesic distance to other nodes, lower numbers would indicate a node to be more central while higher values indicate it to be more peripheral.

The betweenness centrality measures the strength of an actor's ability to broker between groups in a network. Freeman (1979) defined betweenness as a measure of how often a node falls along the shortest path between two other nodes. The mathematical formula for betweenness centrality of node j is given by:

$$b_j = \sum_{i < k} \frac{g_{ijk}}{g_{ik}} \tag{3.1}$$

where g_{ijk} is the count of geodesic paths that *j* is connecting between *i* and *k* and g_{ijk} is the total count of geodesic paths connecting *i* and *k*.

Eigenvector centrality measures the extent to which an actor is connected to other wellconnected actors. In our context, eigenvector centrality is a variation of degree centrality in that we count the nodes adjacent to a given node with ties but on top of it, those adjacent nodes' centrality is also weighted in. The formula for eigenvector centrality is represented as:

$$e_{i=\lambda}\sum_{j}x_{ij}e_{j} \tag{3.2}$$

where e_i is the eigenvector centrality measure for the node of interest, and λ is the eigenvalue, which is a proportionality constant, X_{ij} is the matrix where *i* is the node of interest with all other node *j*.

Figure 3.6 shows the relationship of degree and closeness centralities. The strength of degree is depicted by the size of the nodes (bigger the stronger degree) and closeness by its color (red is stronger, blue is weaker). Similarly, Figure 3.7 illustrates an example of the relationship of degree and betweenness. Here, degree is denoted by size and betweenness by color. Using the name generator and the three centrality measures will enable me to determine the patterns of interpersonal connections and identify the importance of individual roles in TWIN-CS.



Figure 3.6. Example of Relationship of Degree and Closeness Centralities



Figure 3.7. Example of Relationship of Degree and Betweenness Centralities

UCINET calculates various centrality measures and some examples from our sample network is shown in Figure 3.8.

Centrality Measures

		1	2	3	4	5	6	7	8	9
		OutDeg	Indeg	Out2lo	In2loc	OUTARD	INARD	outclo	In⊂los	Betwee
1	John	2.000	1.000	6.000	6.000	3.500	3.000	8.000	9.000	0.000
2	Becky	3.000	3.000	7.000	10.000	4.000	4.000	7.000	7.000	6.000
3	Abbey	3.000	1.000	8.000	4.000	4.000	2.667	7.000	11.000	0.500
4	Sami	3.000	5.000	7.000	14.000	4.000	5.000	7.000	5.000	10.500
5	Mike	1.000	2.000	3.000	7.000	2.833	3.500	10.000	8.000	0.000
6	Sarah	2.000	2.000	4.000	8.000	3.333	3.500	9.000	8.000	1.000

Figure 3.8. Example of Centralities Measure Output

Cohesion. While centrality measures individual actor's involvement in a network, cohesion provides measures of the structures at the network level. Borgatti et al. (2013) described cohesion as how strong the members are connected with one another or a way of

observing the network's well-knittedness. Some important cohesion measures include: density, component, connectedness, compactness, and fragmentation.

Density is simply the proportion of the total number of ties observed in a network by the total number of possible ties. The higher the density, the more nodes are connected and I can interpret this as highly engaged in learning to implement TWI models through specific questions and answers among members. A component could be thought of as clusters within a whole network defined by a set of all possible nodes in which every node can reach every other node. Our network example in Figure 3.5 has one component because all six individuals can be connected through the directed paths. While this is often the case with smaller networks, the likelihood of components to emerge increases as network size grows.

Connectedness is the proportion of pairs of nodes that are located in the same component mathematically represented as:

$$\frac{\sum_{i\neq j} r_{ij}}{n(n-1)} \tag{3.3}$$

where *i* and *j* are two any two distinct nodes in the network and $r_{ij} = 1$ if *i* and *j* are in the same component and 0 otherwise. Fragmentation is calculated by (1 – connectedness) which means that it is the count of pairs of nodes that cannot reach each other.

Compactness is a slight variation of connectedness, which weighs the paths connecting the two nodes inversely by their length. Mathematical formula for compactness is represented as:

$$\frac{\sum_{i \neq j} \left(\frac{1}{d_{ij}}\right)}{n(n-1)} \tag{3.4}$$

where r_{ij} term was replaced by (1/d_{ij}). In compactness, d_{ij} represents the geodesic distance from *i* to *j*. An example of the UCINET cohesion output is shown in Figure 3.9

		propos al_sam ple_1
1	Avg Degree	2.333
2	Deg Centralization	0 200
4	Out-Central	0.160
5	In-Central	0.640
6	Density	0.467
7	Components	1
8	Component Ratio	1
10	Fragmentation	0
11	Closure	0.370
12	Avg Distance	1.600
13	SD Distance	0.611
14	Diameter Wieper Index	5 40
16	Dependency Sum	40
17	Breadth	0.278
18	Compactness	0.722
19	Mutuals	0.267
20	Asymmetrics	0.400
21	Arc Peciprocity	0.333
23	Dyad Reciprocity	0.400

1

Figure 3.9. Example of Cohesion Measure Output

Qualitative Data Procedure

There are two primary sources of qualitative data for this dissertation: archival data and semi-structured interviews. These two data sources will respectively answer the first research question which reads, "how are the organizational features of TWIN-CS facilitating productive learning among participants implementing TWI model?" and the third question which asks, "how are the individuals' roles associated with promoting a productive community of practice in implementing a TWI model?" Unlike the second research question, where I will have identified the level of each participant's role within TWIN-CS and how their roles play a factor promoting collective learning through quantified measures, the third question inquires how the network members engage themselves in learning to implement TWI models. This involves qualitative

data to be collected through semi-structured interviews and I analyzed the details to complement the quantitative data from the network survey.

Step 1 Transcription: My first step in analyzing the interview data was to transcribe the audio files recorded during the interviews. I asked permission from all interviewees to record the full interview and securely save the audio files in the IRB approved server. On average, each interview lasted approximately 30 minutes (Min: 18 minutes, Max: 45 minutes) so the full interview ran for about 7.5 hours. I followed the traditional method of transcribing by listening to each mp3 file and typing in the discussions in Microsoft Word documents, and following "stop and go" on the media file as necessary while I typed the conversations. Archival data are available through field notes, webinar recordings, and prior evaluation surveys so that transcription was not necessary.

Step 2 Open Coding Process: The second step involved a qualitative coding process. Raw qualitative data often involve large volume of unstructured narrative or observational data. Thus a coding process aggregates or structures qualitative data into smaller chunks of information while seeking relevant evidence from the dataset to the constructed codes (Creswell, 2013; Miles, Huberman & Saldaña, 2013). The first step in my coding process began with careful reading of the interview transcripts and archival documents. I then imported all transcribed interviews and archival data into NVivo 11 (NVivo 11, QSR International, Ltd. version 11, 2015) to aid my analysis. A computer program, such as NVivo, is helpful in qualitative analysis in that it provides a database structure for all imported data, is easier to search or locate specific chunks of data within codes, manage analytic memos, and run queries such as word frequencies or pattern recognition. As I read through the transcripts and archival data, I observed for any commonly mentioned themes, repeated suggestions/comments, and any potentially interesting comments or key words that may relate to answering the qualitative research questions (Questions 1 & 3). Merriam (2009) defines this initial review as an "open coding" process and recommends the researcher to be as expansive at this stage. The primary goal of this open coding is to initiate a qualitative analytic process to (a) organize qualitative data into easily manageable structures to draw meaningful insights related to the study's purpose and (b) begin identifying segments in the data that may provide potential answers or part of an answer to the research questions (Merriam, 2009). In addition to the interview transcripts, I reviewed relevant archival data following the same process and noted any data that paralleled or complemented the interview data. Archival data sources specifically came from the post-Academy evaluations filled out by participants and the initial case studies of the participating schools when they first joined the network.

Guided by Merriam's methodology, I began my open coding by naming codes. For example, the first research question reads, "*Do the organizational features of TWIN-CS facilitate productive learning among participants implementing TWI models? If so how*?" From this question, I named three open codes to help find qualitative evidences directly related to answering the question. These codes are: (1) *Organizational Features*, (2) *Types of Productive Learning*, and (3) *Ways of Productive Learning* (see Table 3.7). I organized these codes into subcodes that provide a hierarchy analogous to parent-child relationship (Gibbs, 2008). Parent code *Ways of Productive Learning*, contains subcodes such as *Face-to-Face* or *Sharing Experiences* where interviewees' direct responses that identify or support the importance of faceto-face interaction or experience sharing were coded. A phrase from one of the respondents' codes for *Sharing Experience*: "Being surrounded by all these people and listening about their ways of doing it, their own ways of looking at it, you learn so much from these interactions". A fundamental concept of CoP is that knowledge development is relational and that people learn through interactions and shared experience (Lave & Wenger, 1991). This concept influenced my coding as I repeatedly read the transcripts and archival data.

Analytic Memo. Throughout the open coding process, I wrote analytic memos to keep track of my coding process and code choices while reflecting on how various issues from the qualitative data relate to larger theoretical or methodological issues to address research questions (Saldaña, 2012; Bogdan & Biklen, 2007). I used analytic memo to ensure alignment with the purpose of my coding and how it could prompt deeper meaning from my analysis (Clarke, 2005). It is easy to lose track of coding consistency during the initial stages because I scanned through 15 interviews, lasting over seven hours of aggregated recording time, on top of archival data. Moreover, analytic memos helped me focus on emerging patterns, themes or concepts and circle these back to my research questions. The ultimate goal of open codes was to develop these as part of a broader scheme of classification (Saldaña, 2012).

Open coding covered a wide spectrum of transcribed interviews and archival data and this process has taken several weeks, while manually coding each and every chunk of data in NVivo. Hence it was inevitable for me to revise initial codes to assure unity and structure by aligning how I have defined and decided my codes (Miles, Huberman & Saldaña, 2013).

Table 3.7

Open Codes

	Codes	Subcodes	Description
1	Organizational features	 ^o Webinars ^o TWIN-CS website ^o Summer Academy ^o Mentors ^o Implementation Team ^o Design Team 	Coding for what the respondents have identified and described as features that helped or promoted their learning to implement TWI
2	Types of productive learning	 Productivity rating Support from outside TWIN General support Growth and expansion in learning network Seeking advice Awareness and direction Experience level 	Coding for respondents' perceived productive learning in a network
3	Ways of productive learning	 Sharing experience Structured guidelines or goals Staying connected Research or data driven Face-to-Face Building relationships Professional development Technology Targeted and focused communities Parental involvement 	Coding for evidences of how productive learning takes place
4	People promoting productivity	 Mentors promote productivity Principals promote productivity Design team promote productivity Teachers promote productivity 	Coding for individuals' roles and their associations with promoting a perceived productivity in CoP
5	Productivity in implementing TWI	° Enrollment ° Staffing ° TWI model	
6	Challenges	 ^o External challenges ^o Internal challenges ^o Lack of resources ^o Lack of knowledge ^o Language & culture ^o Over-reliance on certain individuals ^o Retaining connectivity 	Coding for challenges respondents face in promoting productive communities of practice

Step 3: Second Cycle of Coding

The next step after open coding was to revisit these codes and group related in contents or that seem to narrate similar stories. This process is also called "axial coding" or "analytical coding" (Corbin & Strauss, 2007). Merriam (2009) suggests that the categories should follow these guidelines: categories should be (1) responsive to the research purpose, (2) sensitizing in that the naming should be as sensitive as possible to what is in the data and (3) conceptually congruent meaning the level of abstraction should characterize all categories at the same level (p. 185-186).

The goal of second cycle coding was twofold: (a) to further condense numerous open codes from the initial cycle and (b) to further analyze patterns for the emerging categories or themes associated with research objectives (Saldaña, 2012). Pattern coding is explanatory and inferential to identify emerging themes or categories and summarizes into smaller number of sets for meaningful interpretation of data (Miles, Huberman & Saldaña, 2013). A second cycle pattern coding was appropriate for my research because it is particularly useful for examining social networks and patterns of human relationships as well, in addition to the formation of theoretical constructs or categories (Miles, Huberman & Saldaña, 2013). In sum, the second cycle of coding was an effective reduction of data into more meaningful codes. Cross referencing these codes with my analytic memos, the research questions, and the transcripts themselves, several overall themes were generated, linked directly to the qualitative research questions.

Chapter Summary

This chapter primarily focused on describing the methodological procedure and it detailed the structure of the overarching research design. My dissertation is a case study of TWIN-CS with the unit of analysis clearly defined by 63 individuals affiliated with 10 network

schools. Data sources came from three key areas: archival, network survey, and semi-structured interviews, which were collected to address the research objective in understanding the "extent to which educators in a relational network promote productive communities of practice."

Qualitative research questions (1 and 3) employed cyclic coding (Saldaña, 2012) with subcodes. The first round of coding sought for narrative evidence, as gathered from interview transcripts and archival data, and coded these to reflect what the research questions are asking. The second cycle of coding sought to condense open codes and was specifically used to find themes that emerged from the relational network activities. The quantitative strand employed a social network analysis survey which gathered respondents' demographic and relational data as well as Likert-scale items to capture the characteristics of relationships.

Chapter 4: Organizational Features and Productive Learning

Chapter 4 discusses the qualitative results for Research Question 1. The qualitative data source includes individual interviews and archival data and were coded to structure evidence for answering the first question. In this chapter, I developed four key themes by analyzing patterns that emerged from the codes.

Research Question 1

Do the organizational features of TWIN-CS facilitate productive learning among participants implementing TWI models? If so, how?

According to the CoP framework, communities are not limited by formal structures. Rather, they create connections among people across organizational structures or geographic boundaries (Wenger, 2011). So instead of predefining organizational features, I used responses from the TWIN-CS members to identify, code for, and examine the features and their use to promote learning. In reviewing the codes and analytic memo, I developed four themes related to answering the first research question.

- 1. Organizational features are platforms for learning growth and expansion
- 2. The expansion of CoPs beyond TWIN-CS prompts productive learning
- 3. TWIN-CS lacks clear internal structures and role definitions
- 4. Sustained connections are vital for productive learning

Theme 1: Organizational features are platforms for learning growth and expansion

Based on my analysis of the interviews, I identified five key organizational features: (a) webinars, (b) the Summer Academy, (c) the design team, (d) TWIN-CS website, and (e) implementation teams. These five features were repeatedly mentioned by majority of the interviewees and many of them shared their thoughts about how crucial these features are for

their learning. In particular, webinars and Summer Academy were mentioned by almost all interviewees across the four groups.

After identifying the organizational features, I then examined to determine the degree to which these features pertained to productive learning. Based on the analysis, webinars and the Summer Academy emerged as two of the most important features based on how frequently – most spent several minutes to share their thoughts about these two features – it was mentioned by how many interviewees (nearly all interviewees).

Furthermore, I observed patterns from interviewees that could be organized into three subthemes for webinars and the Summer Academy. These sub-themes included the following:

- "Helping other members to overcome challenges"
- "Sharing a wealth of knowledge"
- "Staying connected"

Helping other members to overcome challenges. Most interviewees mentioned learning from members from other schools in the network to help overcome challenges. For example, as one mentor mentioned, "people who are experiencing challenges have a bunch of people kind of thinking and chiming in on it. I think that's been beneficial to everyone that gets to be on [the] webinar." A teacher from a different school shared similar thoughts: "[The webinars] are really helpful. I mean . . . we would discuss issues and problems, lay everything out on the table, and someone out there is bound to know something about it or shed some light on it for us."

One principal whose school struggled to maintain enrollment talked about [an] "aha" moment in a webinar:

In one of the webinars, I think it was [principal's name] sharing their years of experience, of failure and success, and with my team [listening in] it was an "aha"

moment. It was an "aha" moment, not that it took the pressure off, but it took the pressure of failure off.

It appears that the commonly shared idea among TWIN-CS members is this "I am not alone" feeling coming through webinar participation and helping find solutions for each implementation team's problems.

Several teachers also mentioned the learning growth that they took away from one another through webinars and the Summer Academy. One teacher described the growth of the Summer Academy: "This is the third time I've been to [the Academy] and I can already see more targeted sessions, workshops, and speakers for different needs. I can see the growth in the program." A few other teachers saw webinars and the Summer Academy as a productive tool for learning and found participation in these organizational programs to be valuable. For example, one teacher described the webinars and the Summer Academy as: "When we are participating at these things, we are all talking, listening, and learning in a more productive way. It's a wonderful experience for me as I pick up something new each time." Based on the analysis, webinars and the Summer Academy provide a structural platform for members to share their experience to help mitigate each other's challenges and expand their learning in the process. This sharing of experience recurred throughout the interviews, and further discussions are included in sections below.

Sharing a wealth of knowledge. Through webinars and the Summer Academy, members seemed to be enlightened by hearing other member's experience in overcoming challenges, obtain new knowledge about TWI implementation from other's expertise, and challenges each other to think about better ways to improve their instructional practices in a TWI setting. During an interview, one principal shared her frustrations in lacking resources and knowledge to transform her school into a TWI school. After participating in all three Summer Academies, she developed strong positive thoughts about sharing a wealth of knowledge: "The experts that we've experienced at the Academy, the wealth of knowledge that is shared with us has been incredible, and not something that we're used to on the Catholic school level." I probed her about what she meant by the "Catholic school level." Her response was that she had meant it in two ways: "As a stand-alone school, we do not have the knowledge and expertise to pull this and . . . I think most Catholic schools, in general, would have similar problems." Another principal from a different region thought that "there is nothing more important than this Summer Academy . . . all this training, learning, they are key."

Another veteran teacher in a bilingual program said that shared experience is not unilateral but sharing her knowledge to other teachers has its own values:

I share my experience to young teachers and see how they are enlightened, learn, and grow from these interactions. That's special. It also opens my eyes, and rewarding and helps me focus on what I am capable of doing best.

Most mentors hold doctoral degrees (8 of 10) and are experts in TWI research and practices. Their professional background in research and a tendency to push for new ways to think about learning clearly stood out throughout the interviews when discussing the role of TWIN-CS organizational features in facilitating learning. Mentors saw webinars and Summer Academies as great opportunities for people to challenge each other, to think deeply and develop new ideas, or to lay foundations from the new knowledge obtained. For example, one mentor said, "I think we network through the webinars, it pushes the thinking of the people . . . really just by asking questions probing to push each other in terms of how do we make this work."

Another mentor said of the Summer Academy, "The diversity in the presentations and workshops of the Summer Academy, are fundamental for the whole faculty as they lay the foundation for their school [in implementing the TWI model]."

In summary, principals and mentors showed a tendency to pick up new knowledge from others and challenged each other to think deeper collectively and resolve problems through webinars and the Academy. On the other hand, I did not find teachers explicitly speaking about learning new ideas by pushing each other to solve problems through webinars and the Academy.

Staying connected. Based on Wenger's (1999) CoP framework described in the literature review, members in a CoP sustain relationships by addressing a common interest domain (Mutual Engagement). These members share ways of engaging in doing things together and strive to know what others know, can do and contribute to this enterprise (Joint Enterprise), while using specific tools, devices, and routines to communicate knowledge and propagate innovation (Shared Repertoire). So far, I discussed findings about how TWIN-CS members engage on critical organizational features (mutual engagement) and learn from others' experience or challenges and obtain a wealth of knowledge (shared repertoire) to lay foundations to implement or transition into TWI models (joint enterprise). The final component of Theme 1 was the impact of "staying connected" and how the aforementioned critical organizational features helped people to stay connected.

One distinctive feature of the Summer Academy is that it is the only time when network members actually can meet in person. Many interviewees thought that meeting people face-toface at the Academy has "helped learning in a more productive way" through efficient communication and "an opportunity to build relationships." Another teacher agreed, saying, "You have to come to the Academy and have the personal encounters to feel like you can access the people that you want to access." Because of the unique benefits of face-to-face interaction at the Academy, a third of all interviewees explicitly mentioned that the Summer Academy as the place where "the only" or "the most" learning occurred throughout the year.

As effective as members thought the webinars were, most felt that it was necessary to meet other members in person at the Academy and to use webinars as another opportunity to reconnect and stay connected. As one of the teachers said, "[After the Summer Academy] people get to stay connected over the course of the year when we're not here physically, partly, face-to-face with somebody in the webinars." This repeated mentioning of the importance of "face-to-face" interaction and "retaining connections beyond the Academy" led to development of the second theme. More discussion about how members view the importance of retained connectivity is addressed in the discussion of Theme 4.

While almost all interviewees saw the webinars and the Summer Academy as critical organizational features of TWIN-CS, the presence of (and the role of) the design team, mentors, and the TWIN-CS website were additional features mentioned by at least a third of all interviewees.

The Boston College design team. In reviewing the transcripts, two interesting trends emerged about the design team as an organizational feature of TWIN-CS. First, the principals mostly thought of the design team as a "credible resource," one that "legitimizes" TWIN-CS to their school board, parents, and potential donors. One principal of a successfully growing TWIN school said, "The design team gives my school tremendous legitimacy. Being able to talk about the association with Boston College impresses people. It impresses donors, the Dioceses, the parents." Other principals saw the design team as a great group of experts from which to seek advice or gain knowledge. One principal talked about how she "heard from many principals talking about their connection or relying on the Roche Center [the design team] to ask questions." In addition to viewing the design team as knowledge experts, this principal's comment reveals another important finding that was evident from the social network structure (discussed in Research Question 2) and the association of roles in productive CoPs (Research Question 3), which is a tendency toward high dependence on the design team. I discuss this more in the results of the next two research questions.

The second finding about the design team is that it is not mentioned by teachers and mentors. In fact, no teacher mentioned the design team in the context of organizational features that promote learning. This lack of a teacher-design team connection actually foreshadows the findings from the network structure analysis and are addressed in detail in the discussion of Research Question 2. It was interesting that of the four mentors interviewed, only one mentioned the design team and did so in passing. In this mentor's view, the design team is a strong feature that "provides research expertise" and "data-driven insights" to inform the implementation teams.

Based on the analysis, there seems to be a disconnect in how different groups view the design team as a resourceful organizational feature. While principals saw the design team as a strong knowledge resource, no such evidence was found from the mentors and teachers.

TWIN-CS website as a knowledge hub. Principals and teachers, in general, saw the TWIN-CS website as an important organizational feature that has steadily expanded as a resource hub. One teacher commented, "Oh yes, having that resource [TWIN-CS website] there and just knowing like, oh, I can go to the site and look things up there is very helpful." Every principal interviewed also mentioned that the website as a "growing knowledge database" and welcomed the "increasing resource where [they] can watch videos or read about new contents."

One principal saw the TWIN-CS website as an archival storage of information and resource that can be looked up for future references. She said, "[TWIN] website is where people who are interested could post things that are around a particular/focused topics" Another principal agreed with similar response, "Okay, [we all] need to go to the TWIN-CS website [regularly]. [We] need to go click on the resource and watch the recorded videos and learn about how we [properly administer the Woodcock-Munoz assessment].

The TWIN-CS website has made a remarkable improvement since the network started in 2012-2013 school year. Early version of the website was limited to providing the mission statement of the network and descriptions about the faculty and staff members as well as general descriptions of the 10 original network schools. As of 2015-2016 school year, however, the website has expanded its function into a library of resource for TWIN members as well as the general public. New features include, a Media Gallery section where over 25 media coverage articles and video clips of TWIN schools, dating back to May of 2012 are housed. In addition, dozens of past webinar recordings are archived and are regularly visited by implementation teams. Lastly, all four Summer Academy agenda, presentations, and workshops are archived for recollection and a valuable knowledge resource.

While TWIN-CS website received accolade from those who used its features as a knowledge resource, several members also pointed out that they "rarely" or "almost never" visit the website. The main reason for this low access to the website was the lack of recognition of the level of information available. Some form of "I didn't know…" was a common response from those who rarely accessed the website. Those individuals with rare access seemed to perceive the website as a place that posts introduction about the Roche Center and updates related to the Summer Academy.

Implementation team. The final important organizational feature was the presence of the implementation team. Each implementation team represents a TWIN school, which comprises principals, mentors, and teachers directly involved with implementing the two-way immersion programs.

From the transcripts, it appeared that the mentors saw great importance in the implementation team as a critical organizational feature, while principals tended to gravitate towards the design team, as discussed above. Of the implementation team, one mentor said it was "where we reflect, brainstorm, and really collaborate as a group. I don't feel like I'm coming in and telling them how it needs to be done. They reflect as a team and work together by questioning and answering to develop a plan and move on." The implementation team is valuable in that the team can hold regular face-to-face meetings to map out things and really try to ask questions and consider new ideas to meet their goals.

Another mentor described the optimistic progress of his/her implementation team over the 2014-2015 school year and how they are on track to meeting their goals.

The [school name] team, have met at least once a month [this past year]. A lot of good things are starting to line up with the K-2 teachers pretty consistently. Just mapping out things and really trying to ask some of those questions about, "why are you doing it that way? Would you consider [something new or different]?" I feel like as a team, we are on a good path and I am looking forward to thinking about the goal we are going to meet.

Implementation team was also viewed as a great opportunity to engage multiple voices into the conversation of learning to implement TWI. For example, one principal expressed how the implementation team meetings helped her teachers to integrate their thoughts in future planning. She stated, "Having an implementation team and having us come together to create a plan has helped, because it's not my plan or the administration's plan, there was teacher voice in it"

Archival data from internal TWIN evaluation in 2014 adds additional evidence of how much TWIN members place importance in their implementation teams. The evaluation showed that 89% of all respondents felt comfortable about meeting the meets of their TWI student in their respective schools. Moreover, 82% of the respondents felt getting assistance was easy when they needed assistant in helping their TWI students to meet their program's goals, and 78% agreed that they found sufficient expertise to meet the needs of their TWI students. The implementation teams also tend to meet regularly as 80% of the respondents said their teams meet at least once per month and 87% of them found the meetings to be moderately or highly beneficial.

Summary of Theme 1. The discussion around the first theme of the first research question (*Do the organizational features facilitate productive learning*?) focuses on what these features are and how TWIN-CS members view them in their learning practices. In reviewing the data, four key components led to the development of the first theme. First, webinars and the Summer Academy are critical features for learning as evidenced by a vast majority of the interviewees. Secondly, organizational features provide a platform for members to share their experience, to challenge each other to think deeper, and to resolve problems collectively. Thirdly, the TWIN-CS website and the design team provide a wealth of knowledge and content resources, and lastly, members tend to stay connected via the implementation team within schools and through webinars and the Summer Academy for cross-school connections.

Theme 2: The expansion of CoPs beyond TWIN-CS prompts productive learning

A discussion of the first theme highlighted the importance of organizational features of productive learning for TWIN-CS members. Discussion of the next two themes will shift gears and address what "productive learning" is for TWIN-CS members. Evidence from the interview data suggests that the productivity can have external and internal components. I first discuss the external productivity in Theme 2 and internal productive learning in Theme 3.

The second theme emerged primarily through interview data, as CoPs of learning to implement TWI models are not necessarily limited within TWIN-CS, and many sought benefits from external resources. During the coding process, I was quite surprised to see a majority of interviewees (11 out of 15) speaking about how they would benchmark other non-TWIN TWI schools in their local area or connecting with content experts in dual-language or TWI education outside of the network to learn about implementing TWI models. In a sense, the TWIN-CS members are creating connections among people across organizational structure or geographic boundaries, consistent to Wenger's (2011) framing of how communities are not limited by formal structures but create connections among people across organizational structures or geographic boundaries.

One example of such an external connection is through non-network schools. One mentor from a TWIN school raised this point of external connection: "Let's take *Y Chinese Immersion School* [non-TWIN school], for example, who are invited to [the Summer Academy as guest speakers]. They have more experiences and more resources, and they already responded to our need." A principal described her practices of not confining herself within TWIN-CS thus: "If I'm lost in something, I will find somebody who's very close, like a neighboring public dual-language school, or somebody that I already know." Another principal added, "What about the

high-performing schools that have been around for decades? What are they doing? I'd love to site-visit these schools. That would be really helpful."

In addition to external schools and individuals to promote productive learning, one teacher also mentioned that international organizations and foreign embassies are productive learning resources:

When I was in the public schools, we have an ISAA, which is an organization based in Spain, International Studies Abroad Academy. People ask, "What is ISAA?" I told them we received resources from Spain through the Spanish embassy for language learning tools.

In addition to Spain, there are dozens of countries, most of which are within proximity to the United States, that have consulates in cities where our network schools are located. Consulates potentially can provide helpful resources and other partnerships with a number of our schools.

Whereas principals and mentors spoke mostly about external connections through benchmark schools and high-performing schools within proximity, teachers tended to speak about the local community, especially parents, as a source of valuable external connections for their own development in a TWI setting. They saw a need to share ways of getting parents on board as part of the TWI learning process. One teacher mentioned, "We have to [find out a way to] get the parents involved. Parents need to be thinking beyond, 'Hey, my child is learning Chinese. it's cool,' to getting on board with our program and become supporters." Another teacher added, "We need to educate the parents to keep them and their family, to establish trust, and to share their cultural identity within our program." Teachers also saw parents as great resources. With regard to this idea, one teacher said, "To extend, to bloom, and grow, and have more people involved, and that's a good network, right? Parents are great resources in that regard." Another teacher agreed:

It's not easy to convince them. It's not so that they come overnight. But again, how you approach, how you attract, how you welcome them will ultimately win them . . . you need to have connections with parents all the way through.

Within the topic of external connection, it was interesting to find that both design team members whom I interviewed expressed the need for these local networks beyond TWIN-CS. One design team member said, "There are people locally that can help our schools. And so we could start helping them create their own networks locally." Later in the sections of research questions 2 and 3, I discuss findings of the design team's role and presence within TWIN-CS and how they shape the network's characteristics.

Summary of Theme 2. The general consensus among many interviewees, across different groups, is that they agreed on the value of external connections beyond TWIN-CS to promote productive learning. This is consistent with how theorists have envisioned of well-functioning CoPs. Yet, what is interesting about this view is that respondents did not seem to find these external connections as a TWIN organizational feature of but a voluntary practice to gain additional information. Such a practice was established right at the early stage of formulating TWIN-CS out of convenience (i.e., proximity to an experienced dual-language public school). However, as the discussion of Theme 3 would suggest, perhaps part of this external learning connection could be attributed to a lack of internal structures.

Theme 3: TWIN-CS lacks Clear Internal Structure and Role Definition

Internally, interviewees overwhelmingly sought a need for better structures and role definitions for TWIN-CS. All but two interviewees raised this point, and comments related to

this theme were referenced 55 times throughout the interview transcripts. In fact, the code on structured guidelines was the second most referenced topic by the interviewees, only after shared experience in frequency. Data suggest a general pattern towards three key areas lacking internal structuring: (a) organizational-level, (b) individual-level, and (c) clearer goals for connection.

Absence of clear organizational-level structures. Several interviewees raised concerns about the lack of organized structures that could enhance the network functionality and offered suggestions. One example of such a structure involved a strategic partnership at the school level. One principal suggested an idea of a hypothetical structure of big brother, big sister pairing at the school level to offer alternate form of mentorship and learning across the network.

Maybe some of the veteran school will become big brother, big sister kinds of schools? Informal mentor? Like one principal, she's really stressed, she's struggling, it may be something that our school have struggled and overcame. "[Principal's name], can I talk to you, I'm really struggling here, what did you guys do in this situation?"

One design team member raised concerns about the absence of a strong governance structure for the network schools:

A majority of our schools in the network don't have strong, viable boards that have taken on responsibility as they should for the sustainability of their school. We must help, especially the struggling schools, to build a stronger governance structure to sustain their operation.

Another design team member spoke of the disparity in how the network functions are defined and organized:

There are parts of which are very organized, parts were very familiar, and the landscape is clear and you know how to serve the schools. And then . . . there the other disjointed

pieces. So there are parts that are clear to see what's happening to support and communicate and there are parts that are ambiguous; parts that are well-resourced and parts that are not well-resourced. And I feel like that is the microcosm of the network as a whole.

Finally, one new mentor to TWIN-CS summed up nicely to address the point of needing for internal structuring by saying, "What we're doing now is flying the airplane while building it."

Absence of clear of individual-level structures. While the design team and principals spoke much about the absence of organizational-level structures and guidelines, mentors and teachers sought clearer role definitions within their network and to plan for specific group connections, which were popular discussion topics throughout the interviews.

One mentor, who at the time of the interview just completed her first year as a TWIN mentor, suggested:

If we have some kind of clearly established guidelines, these are the things that we can help each other and these are the things that the principals can talk about with the mentors. These are the things that a mentor can think about how to advise the school. If we have something like guidelines like that.

Another veteran mentor also agreed by sharing thoughts about her relationship with the school leadership:

There are times when I go and I'm doing what I'm supposed to be doing, and I think, I have been talking to other mentors this week, doing vastly different things. As part of it is, what does your school/principal want and need? We can't move forward doing things if the school doesn't want it. We can provide critical guidance or whatever, but when the

day is done, we have no authority to ensure things are happening the right way. That's a challenge for me.

One principal from a different school also shared similar ideas. "At times, I wonder, 'who am I going to email? Twenty people? Two people? I need to know what I'm going towards. I'm a planner and thinker. For me, the network is getting too overwhelming."

In some instances, interviewees shared their thoughts on planning a new check in system of routine chats, webinars, or any other ways to stay connected. For instance, as one mentor expressed his view on a routine mentor connection. "Even if it were every other month for ten minutes, where we can check in and touch base would be helpful." Principals also supported this "check in" system. One principal mentioned the following about a check in system:

I think what would be really helpful to me would be some kind of check in system. I tend to do things that I'm mandated to do. I tend to let go of those things that I'm not required to. If there was a mandated check in process for the principals, I would be very likely do it.

Another principal from a geographically nearby school shared similar thoughts: "What might make it even better at times is forcing the issue of principals checking in . . . just principals sitting around the table, via webinar . . . different principals."

Teachers were supportive of the idea of structured guidance and clearer role definition. However, they also looked for opportunities, to look for their own space (either cyber or in person) for them to meet and connect. For instance, kindergarten teachers would love to connect across the network and have a "kinder-connection." One teacher shared her thoughts about the teacher-space. "I think it would be nice if we can have a place where we can share, perhaps videos of us even for like five minutes of teaching to get feedback from other teachers in the network."

Absence of clear goals and planning for effective connection. In addition to the lack of organizational-level and individual level structures, a third structure absent was a set of clear goals and planning for effective connection. This is a topic that the design team interviewees spent a big chunk of their interview time addressing. They generally agreed that the network needs clearer goals and plans for effective network connections. One design team member stated the following about connections:

How do we connect to these people in the first place? What's the shared reason for retaining this connection? It really has to be a very clearly shared connection with a common goal and planned out or it'll just become a waste of time and the connection wouldn't sustain.

Another design team member added to these ideas:

In education, compared to many of the industries anywhere, business or any other sectors, there's little collaboration and sharing of knowledge. It's required. It's essential. But we don't require it here [in TWIN-CS]. But connections need to be purposeful. We [have] got to find a better way to effectively connect people in the network. A long, long time ago, in the early days, we talked about what and why. The "why" is really important.

One mentor also agreed on this point: "It's too open. People sometimes don't seem to know what to do. I think if things are left open for people to just 'go and network,' it's not going to get done. I think people would appreciate some structure." This same mentor also suggested: One idea I was thinking was, maybe take those webinars, even the ones that are already archived, and put them under different stages so that different schools would know, "Okay, if I'm in the exploration stage, then these webinars are a priority watch list." Sometimes, people have a hard time even knowing what question to ask, and I think building structured resources would help.

The design team also seemed to agree on reforming their roles. One member said:

I don't think the design team is working as collaboratively as it should. I think it's basically fallen on [just two design team members]. I think the design team needs to be reformed, reshaped. It needs to . . . there needs to be a rethink of what it is and how it works. We, as a network, have not done our homework as the network has mushroomed.

Summary of Theme 3. With the exception of the annual Summer Academy and webinar participations, evidence clearly suggests absence of robust internal structure at the organizational and individual levels in TWIN-CS. The design team and principals shared their thoughts on some form of mandatory routines, while mentors and teachers were looking forward to their own space where teachers or mentors can periodically touch base as a group. Lastly, the idea of connection also needs to be purposeful. The "why" connection must be thought out to have meaningful and sustainable connections.

Theme 4: Sustained connections are vital for productive learning

The discussion of Theme 4 highlights the importance of sustaining connections for productive learning. In reviewing the codes, one commonly recurring theme was the challenge of retaining connections with members across the network. In fact, many expressed that the Summer Academy was the only organizational feature that connects members. Also, effectively retaining connection across the network beyond the Summer Academy poses enormous challenges for many, especially teachers. Staying connected was also brought up in my discussion of Theme 1 as members saw Summer Academy as a place to build relationships, using webinars to reconnect. The overall response pattern from the interviewees, however, suggests that the webinar was not sufficient to sustain connections throughout the year.

There is a lack of organizational features that facilitate face-to-face time: More face time was a very popular demand from interviewees as currently, the annual Summer Academy is the only feature that allows members to congregate. Below, I highlight a few quotes, among many, that spoke to the importance of face time.

Evidence from interviews suggested that the key reason for the importance of additional face time was perceived effectiveness. Most interviewees thought face-to-face interaction was a more "effective way" to ask questions and seek answers for better learning. One principal spoke to this point, "We definitely need more face-to-face time where we can meet and ask questions that are most concerning us." Teachers also spoke about effectiveness of in person meetings, as the following quotes illustrates the point. One teacher mentioned the importance of actual in person meetings over virtual interactions. "Webinars and phone calls are helpful, but it's not the same as that face-to-face interaction." Another teacher asserted her view of effectiveness stating, "Nothing works more effectively than when you are seeing each other face-to-face, and you are talking about your difficulties and challenges and what you did this whole year."

The quotes suggest the following about the productivity of organizational features. Firstly, the Summer Academy is the only feature that provides members to engage in person and that it provides great platform for sharing knowledge and expertise. Secondly, implementation team meetings promote productivity by raising and answering questions to meet the team's goals, thirdly, implementation team meetings are limited to each school and with the Summer Academy as the only current opportunity for the network to meet, members are raising concerns for additional organizational features that will provide more face-to-face time.

During the interviews, while I listened to how the interviewees described the importance of face-to-face interaction, several of them speculated about the possibility of having regional or localized meetings among schools who are in geographic proximity to create additional face time outside the annual Summer Academy. One principal said:

I know this may not work out but . . . what about a Western or Eastern, or even a regional coordinator, okay the West, the Northeast, and then those people can . . . that would be great for us to visit [another TWIN-CS school] and meet up.

Another teacher also added:

Maybe this would be a far reach but there could be another point of time where we could meet together outside of the Summer Academy. That may be a stretch for everyone, given how people are all over the country. So another point is where people get together regionally or something.

Shared knowledge and experience. Shared experience, and to an extent knowledge, was coded with the highest frequency from the interviews. Every single interviewee mentioned this topic. Below, I highlighted some exemplary quotes from different member groups as to how they believed sharing experiences promote learning productivity.

One principal spoke about the value of her teacher's participation of the Summer Academy in terms of shared knowledge and experience:

Some of the teachers who come to the Summer Academy have reached out to their colleagues across the network if they have a question or something that sparks an interest here. They know who has more expertise and they have gone to them. It's the

fact that when we come to the Academy, we get to learn about a wide range of things. We don't have to become the experts, and you do this, you see who is presenting. If you have trouble implementing something you know who to go to. It's that shared knowledge base.

Another principal stated, "There is not an ego of 'I own this information,' and I find that is really wonderful and healthy and has allowed for more participation instead of a hierarchical passing of information." This statement is consistent with Wenger's (1999) shared repertoire as evidenced by the flow of information and shared ways of communicating the information.

One design team member spoke of the motivational aspects of sharing knowledge: "I feel like these schools take a lot of strength and motivation by looking at what the other schools have accomplished." A new mentor to one of the network schools shared her experience as: "When we hear another school trying something different, something we haven't thought of, we'd be like, 'huh, let's get those, let's do it.' It pushes our implementation team forward."

Shared experience also helps people to expand on their previous perceptions or perspectives. A veteran mentor with decades of experience researching bilingualism also mentioned how the shared experience helped her when thinking about mentoring her school's implementation of the TWI models:

It's nice for schools to have somebody else to bounce something off of. It was interesting as we had breakfast the other morning with the mentors, just the vast experience of the people in the room I think it's great. If we can provide any service to the schools . . . It struck me as that was really something unique.

Another veteran mentor agreed: "Listening to different perspectives has helped us a lot by allowing us to do things we haven't thought of." One principal added, "As I get to know people

and I know more about their stories, then I can see where my story might fit in. I'm more likely to go to them for advice when I need it."

Members were also reassured of their work by listening to what other network schools have done that worked for them. For example, one principal discussed how working with others helped in TWI implementation:

It helped our faculty over the rough spot to know that there were other people doing the same work that you could call upon if the road was too hard for you for a little bit. They would at least point you in the right direction for how to solve things.

Another principal was assured by seeing what other schools have done:

Just to know that there's somebody else, even just to know that they got over this hump and that they continued, sometimes that's the push you need to keep looking for the answer when you're in the trenches and it's like, "Does anybody care that we're doing this? We feel like we're doing it all alone." We aren't alone. That was very helpful. Curriculum adaptations and implementation of a particular model were also popular topics

shared by principals and mentors.

While principals and mentors spoke about the importance of curriculum development and implementation, teachers found that shared experience that benefits their classroom teaching. One kindergarten teacher spoke to this point:

This is the first year that I made real connections with other kindergarten teachers. It was very important for me. We're sharing lesson plans. They're going to show me how they do their 50-50 model. So this opportunity to connect with others and learn from what others know was very important.

Another teacher said the following about the sharing within the network: "Being surrounded by all these people who are involved and they have their own ways of doing [it], their own ways of looking at [it]. You learn so much that way."

Summary of Theme 4. Evidence from the interview data shows that the most important reason for retaining connections is to learn from other members' knowledge and experience. Shared experience motivates, informs, and rewards those who are engaged in implementing the TWI curriculum and teaching. It also validates the work of school leaders. Most agreed in the value of more face-to-face interactions and, barring resource constraints, suggested additional meetings or site visits at the regional level. Such views towards sustained relationship (mutual engagement), along with knowing what others know and how they can contribute to the group (joint enterprise) and flow of information and shared discourse content (shared repertoire) are consistent with Wenger's (1999) CoP framework. However, respondents' views also suggest a lack of organizational features that promote these practices.

Chapter Summary

Evidence from interview data revealed five key organizational features: (a) webinars, (b) the Summer Academy, (c) the design team, (d) TWIN-CS website, and (e) implementation teams. In particular, webinars and the Summer Academy were considered to be the most critical organizational features. Members thought TWIN-CS organizational features promote productive learning as a platform to share experience, provide a wealth of knowledge, and helps them stay connected.

Productivity can have external and internal components. Externally, CoPs can and have extended beyond the TWIN-CS and additional learning can take place through those interactions. Internally, members spoked of a need for establishing a robust internal structure at the

organizational and individual levels and clearly defining the purpose of retaining connection. Analysis of the data suggest sharing experience and knowledge to be the most important reason for members to stay connected but limited face-to-face interaction beyond the Summer Academy remains a challenge.

Chapter 5: Network Characteristics and Perceived Productivity

In this chapter, I discuss key findings about the network characteristics and participants' perception of promoting productivity in communities. I begin with a discussion of missing data in the survey followed by a general description of the survey respondents. I then discuss the results for the second and third research questions before concluding with a chapter summary.

Missing Data

As defined in Chapter 3, the unit of analysis in this study is the implementation team members of the ten original network schools and the design team at Boston College. I drew survey and interview data from each of the four population groups that make up this unit: (a) teachers, (b) principals, (c) mentors, and (d) BC design team. In total, 56 individuals³ make up this unit and 49 of them filled out the SNA survey. However, seven responses were not counted in the analysis because they were either incomplete (answered less than half of the items) or did not provide relational information. Thus, the final survey response rate was at 75% (42 valid responses out of 56).

As discussed in Chapter 3, missing data in whole network surveys are often a greater concern than in non-relational surveys and may seriously compromise the robustness of the relational measures (Borgatti, Carley, & Krackhardt, 2006). In reality, any missing node could play an influential role in the network but not be captured in centrality measures. Such representation of network activities creates bias (Borgatti, Everett, & Johnson, 2013). The TWIN-CS network survey's 75% response rate is at the lower threshold of suggested minimum response rates (Kossinets, 2006; Žnidaršič, Ferligoj, & Doreian, 2012). Although various forms of missing data imputations, ranging from simple likelihood estimations to complex Bayesian

³ Originally 63, removed 7 from analysis (see Chapter 3 for discussions)
methods, are used in network research (Huisman, 2009; Kossinets, 2006), I did not employ any form of imputation in this study for the following two reasons.

First, this dissertation is a case study that examined TWIN-CS members' collaborative learning practices. Most members at least know of each other by name and in many cases have met each other at the Summer Academies. While missing a quarter of survey responses in a network like TWIN-CS (where people know each other relatively well) is higher than what I would have hoped for, missing responses also provide some valuable information about the characteristics of certain individuals' level of engagement and involvement in the network. As discussed in Chapter 3, the respondents were provided with multiple motivational reminders and incentives with a month to fill out a relatively short survey that lasted on average about 15 minutes.

Secondly, I observed systematic trends to the missing data. Of the four groups, 100% of the principal, mentor, and design team groups (22 of 22) submitted valid responses. The teacher group, however, had a 59% valid response rate. The teacher group was also the largest in the network (N_{TEACHER} = 34 vs N_{OTHER} = 22). Part of the reason for designing interviews of network members was to capture some explanatory data from the teachers that may have led to a lower response rate. During the interviews, I asked questions that were specific to teachers: "Can you tell me a story about some challenges you face as a teacher in being an active member of TWIN-CS?" and "How do you think the teachers can get more involved in collaborative learning among all TWIN-CS members to help address your concerns?" My analysis of interviews indicates that teachers, compared to the other three groups, are much less engaged in communicating about the implementation of TWI as a group, and teachers who responded to the survey are likely more engaged than those who did not. Thus, the risk of biased centrality measure is likely less of a

factor in this case. Details about the results of these interviews are discussed later in relevant sections of this chapter.

Survey Description

The survey was sent to all participating members of TWIN-CS in May, 2015 with a final response rate of 75%. The general demographic characteristics of the respondents are reported in Table 5.1. Nearly half of all respondents were teachers (20 out of 42 or 47.6%) with the design team being the smallest group (4 out of 42 or 9.5%). Principals (8 out of 42 or 19.0%) and mentors (10 out of 42 or 23.8%) rounded out the remaining respondents who responded. The overwhelming majority of the respondents was female (81%), and exactly two-thirds of them attained post-baccalaureate degrees (66.7%). With the exception of one respondent, all held full-time positions at their respective institutions. About 60% (25 of 42) of the respondents had either obtained or were going through advanced bilingual training, which included took graduate-level bilingualism courses or ESL/TESOL certifications.

A summary of respondents' experience levels displayed in Table 5.2 seems to indicate that while most respondents are moderately experienced as educators, they are much less experienced as educators in bilingual environments. The frequency distribution of teaching experience indicates that the majority of respondents (65%) have at least seven years of total teaching experience ($\bar{X} = 11.2$, SD = 8.8) but far less in terms of teaching in a bilingual curriculum, as 45% of the teachers had less than 3 years of bilingual teaching experience and 65% with less than 6 years ($\bar{X} = 5.6$, SD = 5.8). On average, principals' total experience levels were very similar ($\bar{X} = 11.0$, SD = 8.4) to the teachers, but they have even less average experience as the schools' leader in bilingual settings ($\bar{X} = 3.3$, SD = 2.4). In contrast to the teachers and principals, the mentors were by far the most experienced group as they averaged

nearly 20 years as professionals or academics in bilingual settings ($\overline{X} = 19.6$, SD = 11.0).

Table 5.1

Demographic Characteristics of Respondents

		Frequency	Percent
Role			
Principal/Headmaster/President		8	19.0
Teacher/Faculty		20	47.6
Mentor		10	23.8
BC Design Team		4	9.5
	Total	42	100.0
Gender			
Female		34	81.0
Male		8	19.0
	Total	42	100.0
Highest Level of Educational Attainment			
Bachelor's		14	33.3
Master's (Academic or Professional)		19	45.3
Doctoral (Academic or Professional)		9	21.4
	Total	42	100.0
Current Status as Teacher			
Full time		19	95.0
Part time		1	5.0
	Total	20	100.0
Current Status as a Principal			
Full time without teaching obligation		6	75.0
Full time with teaching obligation		2	25.0
	Total	8	100.0
Did You Complete a Bilingual Education Training			
Program?			
Yes		19	45.2
No		17	30.5
Other		6	14.3
	Total	42	100.0

Table 5.2

Respondents' Experience Levels

	Frequency	Percent	Mean	SD
How many years of teaching experience do	you have?	•		
0 to 3 years	2	10.0	11.2	8.8
4 to 6 years	5	25.0		
7 to 10 years	5	25.0		
11 to 14 years	2	10.0		
15 or more years	5	25.0		
No response	1	5.0		
Total	20	100.0		
How many years of bilingual teaching exp	erience do yo	u have?	•	•
0 to 3 years	9	45.0	5.6	5.8
4 to 6 years	4	20.0		
7 to 10 years	2	10.0		
11 to 14 years	1	5.0		
15 or more years	3	15.0		
No response	1	5.0		
Total	20	100.0		
How many years of working as a principal	in total?			
0 to 3 years	2	25.0	11.0	8.4
4 to 6 years	0	0.0		
7 to 10 years	2	25.0		
11 to 14 years	1	12.5		
15 or more years	2	25.0		
No response	1	12.5		
Total	8	100.0		
How many years have you worked as a pri	ncipal in a bi	lingual prog	gram (Princ	ipals)?
0 to 3 years	5	62.5	3.3	2.4
4 to 6 years	1	12.5		
7 to 10 years	1	12.5		
11 to 14 years	0	0.0		
15 or more years	0	0.0		
No response	1	12.5		
Total	8	100.0		
How many years have you worked in a bill	i <mark>ngual progr</mark> a	um (Mentors	s)?	
0 to 3 years	1	10.0	19.6	11.0
4 to 6 years	0	0.0		
7 to 10 years	1	10.0		
11 to 14 years	1	10.0		
15 or more years	6	60.0		
No response	1	10.0		
Total	10	100.0		

Research Question 2

What are the characteristics of relational networks among participants in TWIN-CS?

The second question examined the relational network characteristics among TWIN-CS participants. Unlike questions 1 and 3, this question is investigated with quantitative methodologies as I explored the relational characteristics using social network data as well as traditional survey items that tap into the respondents' perceptions of their learning activities within school and across the network.

Network Structure Analysis

At the data collection point (May 2015), TWIN-CS was defined as the unit of analysis in this study with 63 individuals from 10 network schools. As discussed in Chapter 3, major internal challenges from two schools led to the removal of implementation teams from these schools, lowering the individual count to 56. The survey asked the respondents to comment on their relationship with other TWIN-CS participants over the course of the past school year (2014-2015) to represent three relational networks: (a) general communication, (b) general advice, and (c) specific question networks. All three network questions asked respondents to identify their relationship in the context of "implementing TWI." Results for these three relational networks are followed with a discussion of network structures, cohesion, and centrality measures.

General communication network. Figure 5.1 represents the communication network's structure. All 56 network members are represented in this network despite a 75% response rate because every member was mentioned by at least one other member who completed the survey. Nodes in Figure 5.3 are color-coded by member groups. Blue represents teachers, red represents principals, black nodes are mentors, and the design team is colored gray. Numbers next to the nodes are anonymized IDs for each member represented in the structure.



Figure 5.1. Whole network structure of general communication.

One notable characteristic of this network is its core-and-periphery structure (Borgtti & Everett, 2000), where a few nodes function as information hubs and gather a disproportionate amount of connections. The four design team members are positioned in the network's innermost core with visibly dense ties connecting to and from them. Principals and mentors also show strong tie density around the outer core of this network structure. Most teachers, on the other hand, occupy the most peripheral positions in this network. This is not surprising because less than 60% of teachers submitted their surveys, and non-response teachers appeared only because another member had identified their names as people they "talked to about implementing TWI."

The visualization of the communication network in Figure 5.1 also suggests that there is a high dependence on the design team when talking about implementing TWI. Moreover, principals and mentors are engaged more in these talks among themselves and with the design team than with teachers. For clearer representation of the core-and-periphery structure, I separated the core nodes and the teacher nodes as shown in Figure 5.2. We can see a dense communication network structure among the non-teacher group on the left compared to the periphery positioning of the teacher group on the right.



Figure 5.2. Core and periphery representation of the communication network.

Additional insights can be gained from examining the weighted ties based on communication frequency. Respondents were asked to identify the frequency of their communication in relation to one of five frequency levels (1: < once/semester, 2: once or twice/semester, 3: once or twice/month, 4: once or twice/week, and 5: > twice/week). Figure 5.3 shows a different representation of the network based on tie strengths of 3 or greater. I chose a tie strength of 3 or greater because contacting another TWIN member at least once a month over the course of a school year seemed like a reasonable frequency threshold to represent regular communication. In Figure 5.3, Colors represent different school implementation teams, shapes represent different roles (teachers = square, principals = circle, mentor = triangle, design team = crossed square), and ties represent frequency strength (solid line = 5, dark dotted line = 4, light dotted line = 3).

I observed two main insights from analyzing Figure 5.3. First, the design team still played a central role in the high-frequency weighted network. The design team, which is

positioned at the center of the network structure, is connected to all but one school. Moreover, the design team appeared to communicate frequently among themselves, as illustrated by solid lines that represent a tie strength of 5.





Figure 5.3. Communication network structure with tie strengths 3, 4, and 5.

Secondly, there is no longer the core-and-periphery structure previously seen in the whole network. Instead, each school's implementation teams create their own pockets around the design team in a sub-hub structure. It is also interesting to note that in all sub-hubs, either principals (circle nodes) or mentors (triangle nodes) play the broker role (stronger betweenness) when connecting the design team with the rest of their implementation teams. Considering this is a high-frequency weight network, the sub-hub structure was an expected outcome because each implementation team works in close physical proximity. Additionally, principals and mentors

were positioned around the outer core of the whole network structure between teachers and the design team, which may explain their brokering roles in the high-weight network.

Three key takeaways from the high-frequency strength network are the following: (a) communication revolves around the design team as a central hub; (b) the principals and mentors play a "broker" role, connecting the design team with their respective implementation teams; and (c) each implementation team functions as its own subunit or sub-hub where teachers mostly engage among themselves within their school. These are visual findings of the network structure analysis and are confirmed by cohesion and centrality measure results in later sections.

General advice network. Figure 5.4 represents the whole network structure of the general advice network. Nodes are color-coded to identify different roles (teachers = blue, principals = red, mentor = black, design team = gray).

One immediately visible characteristic of this advice network is that core-and-periphery structure that was less distinct from the communication network. Instead, I observed a clustered communication pattern, similar to the high-weight network in Figure 5.3. What is different about this network is that, unlike the other networks analyzed thus far, there are some signs of cross-school advice seeking among the teachers. For example, teacher ID 5 and teacher ID 18 from the school in Figure 5.4 reported seeking general advice from teachers 34, 10, and 35 at the gray school. Another feature of this network structure is that there appear to be two groups of members who are central to advice channels. One of them is the chain of the four design teams (brown squares), and another is a chain of principals and mentors corresponding to nodes 50 through 52 to the left of the design team in Figure 5.4.



Figure 5.4. Whole network structure of general advice.

From the results illustrated in Figure 5.4, I observed two findings about the general advice network. First, based on the results from communication network's core-and-periphery structure, I expected the advice network to follow a similar trend with the core members likely being the design team and mentors who are content experts of TWI topics and TWIN-CS program management. Secondly, mentors were not positioned in a core hub or sub-hubs with strong in-degrees (receiving advice inquiries), but they were relatively scattered throughout the network and sought general advice from other members (including teachers), while sharing their advisor role with principals (see Figure 5.5). Notice in Figure 5.5 that the two central groups, one composed of the design team (enclosed inside the red dotted area) and the other including some principals and mentors (enclosed inside the blue solid oval), and several mentors and principals are deviating or detached from the core.



Figure 5.5. Core representation of the general advice network.

Specific question network. The final network structure is the specific question network, where members were asked to identify those to whom they had reached out for specific questions regarding implementing the TWI models. Figure 5.6 represents the whole network structure of the specific question network. Compared to the communication network (no isolate nodes) and advice network (four isolate nodes), the question network has eight nodes without ties to any member in the network. Because the survey asked respondents to identify those to whom they reached out for *specific* questions, which narrows the type of communication, many teachers who did not submit their surveys possibly were not mentioned compared to *general* communication or advice-seeking networks.



Figure 5.6. Whole network structure of specific questions

Another finding from the question network structure is that the core-and-periphery structure with the design team at the inner core *reappeared* in this network. This is surprising given that the advice network showed evidence of detaching from the communication network's core-and-periphery structure. Moreover, seeking advice and questions, although not exactly having the same meaning, can be thought to be closer to each other in practice than having general communications. The former has one person seeking out another person to receive information while general communication could be any form of dialogue exchanged with respect to TWI implementation.



Figure 5.7. Core representation of the specific question network.

Figure 5.7 illustrates the core of the question network. Unlike the communication network structure, another notable characteristic of the question network's core is that the core itself has distinct three layers. The design team members are positioned at the innermost core with principals occupying the immediate outer layer and most mentors covering the core's outer edge. While the communication network showed strong degrees (i.e., high dependence) on the design team, principals in the question network core seem to be much more engaged among themselves in asking and receiving questions (high in and out degrees) both within and across schools. Although principals in the question network played an active role in communicating within and across schools, mentors appear to play more of a broker role between principals and teachers (see Figure 5.8). We can see from Figure 5.8 that all principals, except principal ID 26, has a direct path connecting them without the design team, whereas the mentors broker between principals and teachers.



Figure 5.8. External layers of the specific question network.

In the discussion of the first research question, mentors had asked for the need for clearer definition of their roles as a TWIN mentor. Interviews with the mentors revealed that mentoring practices varied in scope and frequency across different implementation teams as they adopted their own definitions to address their needs. Network structure analysis seems to suggest that mentors play more of a broker role within implementation teams (question network) and across the network (advice network), while actively engaged in conversations with other principals and the design team (communication network). As the network expands, it would be necessary to discuss, as a network, whether to outline a clearer role definition for the mentors or loosely retain current mentorship practice as communication liaisons.

Cohesion Measures

In this section, I highlight the results of whole network cohesion measures. Borgatti et al. (2013) described cohesion as how strong members are connected with one another or a way

of observing the network's close-knit nature. Table 5.3 shows six cohesion measures for the three relational networks. Each network has two sets of measures titled "All Responses" and "Excluded." Results in the All Responses column are cohesion measures for the full network before removing the two implementation teams (n = 63). The Excluded column includes the same measures, but the two implementation teams were removed from the analysis (n = 56). I chose to include All Responses measures to observe how much change in cohesion measures happened as a result of the exclusion. In my analysis, all discussions about the results will be on the Excluded column, except where I compared the two explicitly.

Because the excluded measures removed seven members who did not respond to the survey, overall cohesion measures will have strengthened in the Excluded column. However, excluded cohesion measures did not change much in the practical sense. Recall that degree and distance are centrality measures that are incremented by one integer value. That is, a one-unit increase in degrees or distances represents adding one tie between two nodes. With this in mind, the average degree and closeness in all three relational networks did not appear to have notable changes. From Table 5.3, on average, each member talked to about five other TWIN-CS members (4.9 vs. 5.3) about implementing the TWI model at least once during the past school year. In addition, it took, on average, about two or three people (2.63 vs. 2.60) to reach someone else in TWIN-CS to talk about TWI. Similarly, for the advice network, each member on average spoke to two (1.87 vs. 2.07) TWIN-CS members to seek general advice and close to three for specific questions over the past school year. Average distance was close to three for both the advice and question networks.

Table 5.3

TWIN-	CS	Cohesion	Measures
	-		

		(1)		(2	2)	(3)		
		Commu	nication	General	Advice	Specific (Question	
		Netw	vork	Netv	vork	Netw	vork	
		All		All		All		
	Measures	Responses	Excluded	Responses	Excluded	Responses	Excluded	
1	Avg. Degree	4.889	5.323	1.873	2.071	2.619	2.804	
2	Density	0.079	0.094	0.030	0.038	0.042	0.051	
3	Components	24.000	17.000	46.000	39.000	33.000	26.000	
4	Connectedness	0.591	0.674	0.218	0.269	0.327	0.381	
5	Fragmentation	0.409	0.326	0.782	0.731	0.673	0.619	
6	Avg. Distance	2.634	2.600	2.906	2.890	2.789	2.776	
7	Compactness	0.273	0.316	0.095	0.118	0.144	0.169	

Of the three networks, the communication network has the strongest relationship strength, whereas the advice network is the least connected. The density measure in the communication network (.094) means that only 9.4% of the total possible ties are connected in the network. With 295 total ties observed in the communication network from 3,136 mathematically possible ties (56 x 56), the proportion of total ties observed over total possible ties resulted in a 9.4% density. With density measures under 10%, all three networks are low-density networks (Borgatti et al., 2013).

A component is the count of clusters within the whole network. It is defined as a set of all possible nodes in which every node can reach every other node. In general, components tend to increase proportionally with network size, as the network becomes more complex in relationships. In this study, the component measure increased in an inversely proportional manner with the density measures. Lower density means fewer ties, and fewer ties means less connections. More isolation leads to an increase of components, making it harder for pairs of nodes to connect. Components, unlike other cohesion measures, showed a notable difference between All Responses and Excluded models because the elimination of seven members led to a reduction of isolated nodes.

Connectedness and fragmentation measures have an inverse relationship that is expressed as fragmentation = (1 – connectedness). A fragmentation of .326 in the communication network means that 32.6% of all possible node pairs do not have paths to reach each other, and 67.4% of all possible node pairs have direct paths to reach one another. As observed in the component measure, we see much higher fragmentation in the advice network (.731) and question network (.619), meaning that only about 27% and 38% of all possible node pairs can be reached in the advice and question networks, respectively. Compactness, as discussed previously in Chapter 3, is a weighted version of connectedness that takes path lengths into consideration, yielding a more conservative measure than connectedness (see Table 5.3).

Centrality Measures

In this section, I discuss the results of centrality measures for the three relational networks. I generated two sets of tables for each of the four centrality measures (degree, closeness, betweenness, and eigenvectors). The first set of tables included average centrality measures by role. The second set of tables identifies the most influential individuals in the networks. This information also led partially to the selection of interviewees.

Degree Centrality. As discussed in the network structure analysis, the design team group was the clear frontrunner in the strength of degree centrality measures. On average, each design team member talked to 21 TWIN-CS members, which is nearly three times as many as the next largest group, principals (Average out-degree = 7.9). Mentors (5.2) and teachers (2.9) were the last two groups in average out-degree measures. The pattern remained consistent for the advice and question networks in the same order of out-degree measures by roles. The design

team showed a tendency for higher out-degree measures than in-degree measures (except advice network) when all other groups showed higher-than-average in-degree measures.

Table 5.4

	Communication Network		Advice Network		Question Network	
RoleID*	OutDeg	Indeg	OutDeg	Indeg	OutDeg	Indeg
Design Team	21.3	10.8	5.3	6.0	11.3	5.8
Mentors	4.9	6.3	1.4	3.2	2.6	3.3
Principals	7.9	8.1	4.3	2.8	4.8	6.1
Teachers	2.9	3.6	1.4	1.1	1.4	1.4
SD	6.6	3.6	2.9	2.1	4.0	2.6
Overall Mean	5.3	5.3	2.1	2.1	2.8	2.8

Average Degree Centrality by Roles

Closeness Centrality. Closeness measure is the sum of geodesic distances from one node to all other nodes in a network. In-closeness measures the extent to which a node is *easily reached by others* while out-closeness measures the extent to which a node can *easily reach others*. We could think of closeness as an index of expected time for the flow of information through the entire network. A simple example of a closeness measure is a hypothetical "gossip network." A person with the lowest in-degree measure in this gossip network will hear rumors the fastest, whereas a person with the highest out-degree measure will spread the rumor the fastest. In the context of TWIN-CS, those with the lowest in-closeness will be in a position to quickly receive information, questions, or advice while those with low out-closeness will be in the best position to spread their words (information, knowledge, advice, etc.) about TWI implementation.

Table 5.5

	Communication Network		General Advice Network		Specific Question Network	
Role ID	OutClose	InClose	OutClose	InClose	OutClose	InClose
Design Team	102.5	213.3	293.3	314.5	227.0	251.5
Mentors	178.8	226.8	357.4	342.6	265.0	275.8
Principals	182.1	221.0	334.5	336.1	258.3	255.5
Teachers	289.2	251.1	384.9	383.8	324.5	317.2
SD	135.1	41.1	88.1	53.4	82.0	54.8
Overall Mean	239.9	239.9	364.4	364.4	296.6	296.6

Closeness Centrality by Roles

Table 5.5 shows the average results of in- and out-closeness by group across the three relational networks. Because closeness is calculated by the sum of all geodesic distances across all possible paths in the network, we could interpret the out-closeness of the design team (102.5) as the average path length that a design team needs to reach all others in the communication network. Overall, the role pattern is comparable to the in- and out-degrees discussed in the previous section, with the design team leading across all measures in terms of its strength, followed by principals and mentors. However, the range of closeness measures did not have as much variability when compared to degrees. For example, the mean closeness measures between the design team (strongest) and teacher groups (weakest) only ranged around 1 standard deviation across all three networks, but in the case of degree, the range was between 2 and 3 standard deviations.

Betweenness Centrality. Betweenness centrality measures the extent to which a node lies along the shortest path between every other pair of nodes. It is the sum of how often a node lies along the shortest path between two other nodes. Essentially, betweenness is an index of potential for gatekeeping, brokering, controlling, or synthesizing of the information flow, or liaising otherwise separate parts of the network. The assumption here is that communication traffic flows along the shortest path.

Table 5.6

Average Betweenness by Roles

	Communication Network	Advice Network	Question Network
Role ID	Betweenness	Betweenness	Betweenness
Design Team	372.0	90.2	175.9
Mentors	62.6	25.5	35.0
Principals	103.0	75.1	99.8
Teachers	11.2	10.2	6.8
SD	119.5	60.8	83.1
Overall Mean	59.3	27.9	37.2

Table 5.6 shows the average betweenness by groups in the three relational networks. One immediate finding from this table is that the measures are quite different among the four groups across all three networks. Unlike degree and closeness centralities, where the measures were close and the differences were not as pronounced, we can see a clear "ranking" of the strength of betweenness in the order of the design team, principals, mentors, and teachers. It is intriguing to note that the principals, particularly in the advice and question networks, play a relatively strong broker or liaison role in these networks.

Correlations. I ran some Pearson's Correlations to observe the statistical relationship between Centrality measures and the length of time taught, both in total teaching and bilingual setting (see Table 3.3). First, correlating with number of years in teaching, there were very weak or no correlation with out-degree (-0.15) and out-closeness (-0.05). A weak negative correlation with in-degree (-0.22) and a weak positive correlation with in-closeness (0.29) was observed. This means that members with longer years in teaching tended to have lower ties coming in while they were relatively easily reachable through a positive in-closeness.

Correlating with number of years in bilingual education, I observed some stronger correlational relationships. Strong negative correlation was observed for out-degree (-0.61) while out-closeness was positively correlated (0.57). This shows that those with longer bilingual teaching experience tended not to reach out for questions or advice on TWI implementation, while they served as close liaisons for connecting members to other members. Other relationships were minimal with no meaningful correlation to report (all under 0.1).

Learning Characteristics

The network survey included a separate section with items that asked respondents to characterize the strength of the relationships and collaboration within their schools and across the network on a 4-point ordinal scale (minimal, fair, good, strong) and to explain the primary reason for talking to (and not talking to) some people when learning to implement TWI models. One of the Likert-scale items in this survey asked, "How would you characterize the relationships among the members of your school's TWI implementation team (Q2.20)?" Another item asked, "How would you characterize the relationships among all schools in the network (Q2.23)?" I categorized these items into four relational categories on the same 4-point scale (minimal, fair, good, strong). Q2.20 was included in a survey that was administered to observe the early TWIN-CS functioning within four categories: (a) trusting, (b) advice-oriented, (c) knowledge sharing, and (d) data driven. TWIN-CS conducted a study to explain the emergence of the learning architecture (Wenger, 1999) and found evidence of the emergence of learning within implementation teams (Scanlan et al., 2016).



Figure 5.9. Responses to query: "How do you characterize the relationships among (members of your implementation team) and (across the whole network)?"

To answer Research Question 2, I added Q2.23 to the new survey for this study and compared the changes in results to Q2.20 from the survey administered in December, 2013. All 42 respondents who completed the survey responded to these items. The analysis of characterizing relationships across these four categories yielded three main findings.

Learning relationship is stronger within schools. There is an overall tendency for the respondents to perceive stronger relational activities within their implementation teams compared to cross-network relationships. As shown in Figure 5.9, a majority of the respondents marked "strong" in three of four relational categories (except data driven) within implementation teams, while none of the four relational categories exceeded 25% in "strong" across the network.

Additionally, the perceived relationship among implementation teams appears to have strengthened over the course of 18 months when the same question was asked in an earlier evaluative survey (archival data) that was conducted immediately after the first semester of launching TWIN-CS (December 2013). In the 2013 survey, the "unsure" response option was not included.

After three full semesters (May 2015), the three categories measured in 2013 (trust, advice-oriented, data-driven) all increased in the "strong" category by ~6%–12% range while "minimal" or "fair" responses of either decreased or remained steady. This implies that there is a possibility of strengthening trust, offering (receiving) advice, and conducting data-driven communication within the implementation teams in each school over the course of the first two academic years in TWIN-CS.

Table 5.7

-			Paired Differences						
			Sta	Std Error	95% Confidence Interval of the Difference				Sig. (2
		Mean	Deviation	Mean	Lower	Unner	t	df	tailed)
Pair 1	- Trust_2015 - Trust_2013	.038	.871	.171	313	.390	.225	25	.824
Pair 2	Advice_2015 - Advice_2013	.077	1.230	.241	420	.574	.319	25	.753
Pair 3	Knowledge_2015 - Knowledge_2013	.308	.970	.190	084	.700	1.617	25	.118
Pair 4	Data_2015 - Data_2013	.154	1.084	.213	284	.592	.724	25	.476

Paired Sample T-Test between 2013 and 2015

In all, 26 of 42 respondents from 2015 had also submitted their 2013 surveys. To test for how these respondents' views have changed, I ran a paired-sample *t*-test that compared the means of the 2013 and 2015 results to test for statistical significance in the observed increase in perceived relationship. Results in Table 5.7 show that despite general increase in the mean scores, none of the characteristics had a statistically significant difference. Although the increase was not significant, the evidence showed e a relatively bigger mean increase in the 4-point scale scores for knowledge (+.308) and data-driven (+.154), which are more concrete and substantive elements of learning than advice or trust.

Less degree of data-driven relationship. Respondents seemed to feel less confident on the strength of data-driven relationships compared to the other three categories. It is the only category where "strong" was not the overwhelming majority of the responses. The highest response category was "good" on data-driven relationship for the implementation team (52%) and across network (36%), while only 14% felt a "strong" data-driven connection across the network (33% "strong" implementation team).

Data-driven communication is one of the most critical TWIN-CS initiatives brought up during the 2015 NCEA Conference and the 2015 Summer Academy. In particular, the design team took steps to offer developmental activities to TWIN members on the Woodcock-Munoz assessment results and communicating results through effective data visualizations. As observed in the relatively stronger increase in the use of data-driven relational activities, this trend continued to build in the 2016 Summer Academy, and it would be worth collecting responses on data-driven relationships post-Academy 2016 to observe any changes in members' perceptions on this category.

Less certainty on whole network relationships. Lastly, there is a relatively higher degree of uncertainty among respondents' view on the cross-network relationships. On all four relational categories, nearly a third of the respondents felt unsure about the cross-network relationships, whereas no category exceeded 5% uncertainty within the implementation team. Though it makes intuitive sense for respondents to identify the relative strengths of the internal network vs. cross-network, it is interesting to see unsure responses in the 30% range for cross-network. So I ran a crosstab of respondents' roles versus "unsure" responses to see if there is a dominant group in this response category. The result was quite polarizing as teachers, mentors, and design team groups dominated in "unsure" responses (~30%–50%), but no principal marked the option across all four categories (see Table 5.8). These results are intriguing in that they show members' perceptions of network characteristics. However, we do not know what may have led to these polarizing results based on the respondents' roles. Further explanation about this phenomenon will proceed later in the discussion of Research Question 3.

Table 5.8

		Advice	Knowledge	
Role	Trust	Oriented	Sharing	Data Driven
Principals	0%	0%	0%	0%
Teachers	30%	35%	35%	30%
Mentors	40%	40%	40%	50%
BC Design Team	50%	50%	50%	50%

Unsure Responses to Network Characteristics by Role Breakdown

Reasons for talking to someone. Now that I have discussed the results of perceived relational characteristics, it led me to consider why respondents would talk to someone about implementing TWI models. To capture this construct, the survey asked, "What are the primary reasons why you talk to some people and not others about learning to implement a TWI model (Q2.19)?" Five response options were given as well as a constructive response option for those who have other reasons. In this survey, respondents were allowed to select multiple responses.

Overall responses indicated a strong desire to obtain knowledge from other whom they perceive to have content expertise (81%). A majority of the respondents also said perceived closeness (62%) and shared experience (55%) are important factors to drive conversation with others in the network. In contrast, low responses in requirement (29%) and anticipation of exchanged favor (19%) suggest that most voluntarily reach out to other members in the network rather than in a prescribed or required manner.

In addition to the five categorical response options, I observed more intriguing results from the 24% of "other" responses, where respondents had the option to provide constructive response on their thoughts on talking to others about TWI implementation. It was evident that these qualitative responses have a parallel trend with the themes discussed in Research Question 1.



Figure 5.10. Reasons for talking to someone about TWI.

A common theme that emerged from this constructive response was sharing experience to provide or receive support, which complements two of the top three categorical response options with an elaboration of narrative detail. Responses included the following: "seeking similar interests," "provide knowledge support," "learn from other's experience," and "co-instruction."

In particular, one principal's response clearly relates to this theme and is consistent with my findings from Research Question 1:

Participating in **webinars** allowed me to feel good about reaching out to other TWIN members who are **in the same boat** as we are and working their way through the challenges. Thus, we can also **work our way together** towards success.

In the quote above, I emphasized a few words that captured how an organizational feature helped identify and connect members in the network through shared experience and collaboration in overcoming challenges.

Summary of Research Question 2

The analysis of the results for the second research question proceeded in the following order: (a) network structure analyses, (b) cohesion and centrality measures, and (c) non-relational survey results. On one hand, network structures of the general communication and specific question networks had distinct core-and-periphery structures with the design team positioned at the inner-most core with principals and mentors occupying the outer-core. On the other hand, the general advice network had a different structure as no evidence of a single core-and-periphery existed with two central groups sharing the central roles. Such network structure led to the less dependence on a specific group or individuals in the advice network compared to the communication and question networks. Overall, cohesion and centrality measures confirmed the network structure analysis and non-relational survey results were also consistent with some of the themes emerged in Research Question 1.

Research Question 3

How are the individuals' roles associated with promoting a perceived productivity within communities of practice in implementing a TWI model?

Research Question 3 examined how individual members' roles are perceived in promoting productive CoPs. Although this question mostly draws upon coded data from interviews, I incorporated relational network data and recurring data patterns from the first two research questions to complement the analysis.

Individuals in Research Question 3 refer to the TWIN-CS members, and *roles* refer to the four member groups (teacher, principal, mentor, the design team). Analysis of the results for research questions 1 and 2 also partially framed the development of themes for this final question. In reviewing the codes, analytic memo, results from the network survey, and

converging patterns from the two previous research questions, I developed the following four themes to answer the third question.

- 1. The design team functions as the central communication hub of TWIN-CS
- 2. There is a lack of structured guidance for the teachers to engage in network activities
- 3. Mentors are proactive influencers with varying scope of influence
- 4. Principals play a critical role in promoting productive CoPs by retaining regular connection with other principals and influencing their teachers' network activities

Theme 1: The design team functions as the central communication hub of TWIN-CS

Early evidence of the design team's central role in TWIN-CS emerged during analysis of the first research question and became more concrete in the social network structure analysis. Building on from these aforementioned patterns, I further reviewed the interview transcripts and archival data and found two key roles in which the design team played in promoting CoP productivity: (a) serving as the main communication, research, and data analytic hub for the network and (b) administering network activities.

Communication hub. As the communication hub for TWIN-CS, the design team broadly served two purposes. First, members of TWIN-CS looked up to the design team as advisors to have their questions answered. Members sought to pick up new content knowledge or implementation ideas from them. One principal spoke about how principals would communicate with the design team for advice.

I was one of those who would call or email Roche Center for questions. But when I spoke to other principals, I heard a lot of people saying "I could call Roche Center [BC design team] anytime with questions, throughout the year." Another principal also agreed by sharing thoughts about her relationship with the design team: "The design team is doing so much for the network. They play a liaison by communicating between schools and individual members and help us figure things out."

Some members mentioned that their frequent communication with the design team was to bounce ideas in implementing TWI in their schools. One mentor, for example, said of her conversations with the design team as, "During the mentor phone calls with [Design Team Member X], we always pick up something brilliant and say to myself, 'Oh my god, why didn't I think of that?"

Clearly, we are seeing some evidence of how principals and mentors gravitate toward the design team as the "go to" advisor to have their questions answered or develop new implementation ideas. What is implied here, however, is that the design team is also likely welcoming these incoming inquiries without conditions.

Design team members spoke about how their role as the central communication hub by is not necessarily a bad thing. One design team member shared:

The design team is the hub for all developmental action, activities and I don't think it [high dependence on the design team] is a bad thing at all. I think that it demonstrates we are only in the third year. It demonstrates that they [implementation teams] are still learning and they've got to go somewhere to learn from. I welcome such connections. The comment above confirms how the design team members themselves value connection with other members and welcome the advisory role, at least during the early stage of TWIN-CS.

Beyond looking up to the design team as advisors, TWIN-CS members saw the design team as the research and data experts who would examine, synthesize, and provide results for

their implementation teams. Although principals, teachers, and mentors saw the importance of stronger research and data informed practices, they also felt this as an area to improve.

One design team member said, "It hasn't been a part of the formal research, which is what I had hoped would be, because I think we're not measuring outcomes right now." Another design team member expressed a view on the disconnect between research and data and the capacity to use such data in schools: "There seems to be a lack of a certain capacity in educators, school educators, to know how to be research minded and understand the value of that for their improvement." The second design team member was less concerned about the research results but more about how the findings and data analyses would be used to improve TWI implementation.

The design team members also envisioned the role in the network's transition towards research based and data-driven implementation. "I feel like if I could get that [datadriven/research based] kind of thinking to the schools that would be the thing I would focus most on and I think we're starting to do that." Another design team member asserted that the design team should rethink the scope of the TWIN research.

I think the research has to be broadened. It's been too narrow in scope. I think communities of practices are great, but as an outcome, what does that mean? If we really established communities of practices, how does that impact the families? How does that impact the kids Does it make a difference for the kids that are sitting on the seats? If it doesn't make a difference for the kids that are sitting on the seats, then why are you spending all your time doing it? We're not making that link.

Teachers also recognized the importance of research and data-driven implementation. During their interviews, teachers were generally looking forward to seeing the disseminated results of the research or data analyses to inform and improve their classroom teaching. One teacher said, "[The design team] has very specialized expertise in areas like we might not necessarily get involved during our daily practice. I'm looking forward to their analysis results to see what we might not be aware of." Another teacher added,

[The design team members] are the people who would give us information... They would train us. It will be that they will give us some clues and you can mention how to use those bar graphs, and I'm just happy to see those results of how my class performed and improved.

Mentors saw the use of research and data to inform their schools' implementation decisions. One mentor mentioned, "I think the books that [the design team] has provided, the guidance in terms of theoretical framing, kind of that grounding, and then some of those activities, we've brought those back and hopefully would see how things pan out." Another mentor agreed, "Let's try it [assessment result data analysis] and see it goes, and then re-evaluate.

The interview results discussed in this section showed some evidence of TWIN members' recognition on the importance of research-based and data-driven learning. While many seem to agree on such learning initiative, mentors, teachers, and principals appeared to look up upon the design team to lead such practice. Earlier in the discussion of Research Question 2, I found that respondents were relatively less confident on the strength of data-driven relationships compared to other learning factors such as trust, advice, or knowledge sharing. While many had pointed to research and data as important to learning and implementing TWI, survey evidence showed that research-based and data-driven implementation has not fully materialized yet in practice. Qualitative evidence from this section supports the quantitative survey findings. Administering network activities. Interview data also suggest that the design team influenced the network activities as the primary administrators. Some key administrative role done by the design team included planning various learning activities and promoting the network.

As discussed in the Research Question 1 section, members generally agreed about the importance of webinars and the Summer Academy as learning features for them. The design team, particularly those affiliated with the Roche Center, played a central role in planning and administering webinars and the Summer Academy. As one design team members said, "We select topics, plan for professional development, schedule and work through the logistical details [for webinars and the Summer Academy]." Clearly, the design team's administrative presence played out just as importantly to the network as was their role as advisors.

One design team member spoke about the challenges of promoting the growth and success of TWIN-CS to obtain new financial sources.

As a center sponsoring the program, the cost has doubled this past school year and we still don't have a [financial] source. We don't have a source because we don't have [research based] outcomes to show other than language acquisition outcomes. I think we need to measure more outcomes about the growth and learning of this program [TWIN-CS] and then publish the results to promote our program.

According to archival data in the TWIN-CS website, TWIN-CS grew rapidly during its third year and by the 2014-2015 academic year, seven additional schools have joined the network and participated in the 2015 Summer Academy. Although this case study only included the 10 original network schools, the design team was already playing a central role in the network so the effects of the overwhelming workload came up in the interviews. One design team member

spoke about how the original design team leadership model is "no longer effective" as she said, "TWIN-CS has really blossomed. The concept of a collaborative design team taking the lead is no longer effective." Other members also raised concerns about this high density communication traffic around the design team.

I feel like maybe [the design team members] have too much on their plates. It could be redistributed a little bit. Because sometimes it creates a bottle-neck and things get clogged along the communication pipeline and we don't get anything done.

Table 5.9 shows the top six highest individuals in degree centrality measures for the communication network from the network survey data. We can see clearly the influence of the design team both through their presence (4 of 4 in the top six out-degree and 3 of 4 in in-degree measures in the network) in these rankings and with the magnitude of degree measures (mean degree = 5.3).

Another design team member offered her vision about how the role of the design team should transform in the near term.

What the design team needs to do, over the next two to three years, is begin to spin off and develop a system where other schools that have become more qualified or better experts [of growing expertise and knowledge base] to take lead. How it'll work out needs to be thought through.

Some implications about this immediate future transformation of the design team and thoughts of additional leadership are discussed in Chapter 6.

Table 5.9

Communication Network							
GrpID*	ID	OutDeg	GrpID*	ID	Indeg		
4	41	42	4	28	18		
4	28	20	3	25	13		
2	45	15	2	58	12		
2	58	14	2	52	11		
4	7	12	4	41	10		
4	21	11	4	21	10		

Members with Highest Degree Measures in the Communication Network

*1=teachers, 2=principals, 3=mentors, 4=BC design team

Theme 2: There is a lack of structured guidance for the teachers to engage in network activities

Earlier in the Research Question 2 section, analysis of the network survey showed a lack of teacher participation in TWIN-CS compared to all other groups. Although the network survey quantified and visualized this phenomenon, it did not provide full evidence regarding what led to their lower participation and why it happened. The interview protocol specifically asked teachers about their challenges in participating in network activities and in reviewing the data, teachers often lacked structured guidelines to help them engage more in network activities and retain connection beyond the Summer Academy.

Teachers tended to be relatively isolated within TWIN CoPs. In the first research question section, I found some evidence of teachers' willingness to connect with other teachers across the network and they looked forward to sharing lesson plans or benchmarking other's teaching to improve their own classroom practices. While coding for teachers' role in promoting productive CoPs, one teacher mentioned how she learned from another veteran teacher about communicating with parents. "Oftentimes, it's not just educating the kids but also educating the parents, too. I personally am never good at handling parents and I learn a lot of that from experienced teachers, I ask 'what do you do [in situations dealing with parents]?" Another teacher talked about learning from a veteran member of her implementation team.

We have our Spanish teacher [teacher's name], and she is a veteran teacher, she has thirty years of teaching and then knows about the Common Core, so the younger [teachers] are not freaking out about "Oh my goodness! Two-way immersion and now Common Core! What do we do?" and all that, and she's become a great peer mentor in that regard to new teachers like me.

It appeared that teachers from at least one implementation team built their own internal system of shared knowledge as one teacher mentioned about the teacher resource Dropbox. "So my coworkers started a Dropbox. We videotaped ourselves, our teaching and stuff and so we can put everything in there so we at least are in some sort of communication."

Unfortunately, this energy and motivation was largely confined to the annual Summer Academy or within each school's implementation teams as teachers struggled to retain cross network connections outside of the Academy during the school year. Based on the teacher interviews, they showed some promise in influencing one another (especially among teachers across the network) to improve their teaching in a TWI model but were not reaching that potential in real practice.

Teachers are overwhelmed with workload. "Teachers are just simply overwhelmed," said one design team member when asked about the challenges of finding ways to increase teacher involvement in network activities. One teacher spoke about her greatest challenges in keeping up as a network member beyond classroom.
The primary challenge [for the teachers] is when we go back to the classrooms [after the Academy]. Our school, in particular, has two grades to teach so we switch in the morning, in my case particularly I have first graders in the morning and then 2nd, 3rd and 4th in the afternoon. So we have multi-grades, multi-levels. So to be honest with you, connecting with TWIN-CS, when I go back home that's not going to be my primary concern, it's the day-to-day stuff.

Another teacher who participated in all three academies added,

I came to every Summer Academy; met new teachers, we talked, exchanged new ideas... It's great. There's targeted focus to get together. But when I go back [to my school after the Academy], it becomes very difficult to get involved. There are just too many things to handle each day in my classroom.

As interview data point out, teachers' network activities are limited as much of their daily work is consumed by classroom teaching and other routine tasks that burdens their workload. Findings from Research Question 2 showed teachers located on the periphery of the whole network and teachers' daily tasks overrides their scope of promoting CoPs in TWIN-CS.

A mandated system. Teacher interviewees have also noted the absence of a mandated system to promote their CoPs. In the Research Question 1 section, I noted the absence of a robust internal structure to promote productivity. This was also a recurring theme as a way to promote stronger teacher engagement across the network. For example, one teacher mentioned that a mandate system would lead her to be more involved in TWIN activities.

Maybe it's just a personal issue but I'm pretty committed to not working 12 hours a day. If it's not something that an obligatory part of my work day I probably am not going to do it and I'm going to go home. If there was a mandated process to check into the TWIN network on a regular basis, it will become a higher priority for me.

Another teacher from a different school spoke about a routine teacher only gathering where teachers could connect, without the presence of administrators. "What about teacher-related things rather than the more implementation and administration side of things? I think, classroom-based things would be nice to have a webinar about and share among teachers on a regular basis." This teacher's comment is also consistent with the discussion surrounding teacher's own space to meet and connect.

Theme 3: Mentors are proactive influencers but the scope of their influence varies

Analysis of the interview data suggests that mentors hold a unique position in the network and serve as liaisons to research based and data-driven implementation practices. Most mentors [8 of 10] have doctoral degrees and have years of expertise in research related to bilingualism and biliteracy. Moreover, mentors hold their full time positions at universities or private consulting practices in the same metropolitan area where their respective TWIN schools are located. This is unique advantage in that mentors have the capacity to use research findings and data to inform practice while being close to their implementation teams. Table 5.10 provides an illustration showing how mentors are in a position to offer research and data expertise through face-to-face interactions.

Analysis of the interview data also confirmed these advantages of mentors. One teacher commented about her mentor's role in data-driven conversations.

[Our mentor] is very detailed with data. She really knows the numbers. She's got the percentages and she uses different colors and charts [to explain] what it's supposed to mean, how you should find the teacher's solutions going back in the classroom.

Table 5.10

Role	Close Proximity to Implementation Teams	Research Expertise
BC Design Team	NO	YES
Principals	YES	NO
Mentors	YES	YES

Unique Advantage of Mentors in TWIN-CS

One principal said, "Having the mentor system built into the program is really key. This year, because we were on the second implementation year, I needed to draw on the wisdom of my mentor a lot more. That was really helpful." Another principal offered an interesting observation about her mentor as a liaison between her and her teachers.

It's been very helpful because [our mentor] can say some of the same things that I have said and we often confer ahead of time, this is the message I need them to hear. They accept it from [our mentor], but they don't always accept it from me. The prophet in their own town is not always heard so you bring in an outside prophet.

Another teacher added about her mentor's role in educating on the topic of biliteracy and how teachers would approach reading and writing across different languages.

[Our mentor] held a workshop to talk about how we approach reading across the languages, reading, and especially about writing. She also brought in a professor from [Anonymous University] to come to our school to give another workshop and this was about two-way immersion, solely on immersion. Just on how kids learn language and when you will see results. And how immersion schools usually grow. There was also some evidence of mentors refraining from merely delivering advice and information but helping the implementation team think through and engage in the conversations about TWI implementation.

I like to, instead of me coming in and telling them this is how it should be, I like coming in with questions and having them kind of think about it. I think they [our implementation team] have been really good at kind of reflecting on what's going on, realizing where the gaps are, needing a little bit of my guidance through the questioning, and then we develop a plan and I can say, "Well how about this?"

The comments above seem to suggest two ways in which mentors promote productive CoPs. First, mentors initiate data-driven conversation for their implementation teams by informing how the data could be used for effective TWI practices. Secondly, I found that mentors sometimes externally connected with other research experts in the area to enhance learning about TWI implementation.

Mentors tend to be proactive. In addition to mentors' potential for being liaisons of research and data-driven implementation, I found that mentors tend to be quite proactive, often taking the initiative to reach out across the network to offer or seek advice. For example, one mentor for a member school along the East Coast spoke about her connections with teachers from a West Coast member school. As the only two Chinese-immersion programs in the network, this mentor took the initiative to reach out and connected teachers from both schools.

Last fall, I connected *Teacher X* in *Anonymous School* and *Teacher Y* from my school so that they could discuss about their classroom activities, offer tips to each other... I then reached out to *Teacher X* to discuss possible professional development opportunities for

the two schools. Things started to fit in and we had our first conference call for the Chinese immersion teachers. It's a small move but it's a start.

Another mentor from a different school shared her own account of interaction with other mentors. As the quote below suggests, some mentors were able to sustain their connection and actively initiated collaborative learning based on content interest or expertise.

Mentor A and I met at the last Summer Academy. We had this conversation about maybe starting a writing workshop for the teachers at the next Summer Academy and we have

been calling each other several times through the school year to talk about it. Evidence of the mentor's role in helping principals to plan effective implementation team meetings also stood out as one mentor said:

The school that I mentored is struggling. Soon after I joined the team as a mentor, I recommended that we needed time to have the language teachers and the schools specifically mentoring together so that we can exchange ideas about the specific issues that we've encountered and this year. It's that kind of attending to details, responding to needs that I feel this network is working very well.

One principal also shared this view and spoke her thoughts about the mentors' roles as follows. I think mentors are really helpful in that they can work across two schools and talk about, "Okay this school is going to do this, and we should try this." That for me, she has been able to make those connections that maybe I don't have time for, or maybe she is already thinking about that spin, that process, and that connectivity has been fabulous.

Overall, there is evidence that mentors sought opportunities to sustain connection beyond the Summer Academy to build cross-network learning initiative. Principals and teachers also seemed to appreciate and showed positive engagement with the mentors within implementation teams. But how they interpret the scope of their work varies. So far, I found that mentors tend to proactively influence connecting network members and provide data or research based advice to their implementation teams. However, the level of engagement seemed to vary as some mentors voluntarily reached out to other teachers and principals across network (both from interviews and relational network findings) while some mentors expressed reservations in their influence beyond their implementation team.

One mentor expressed her lack of networking beyond her implementation team over the course of the school year. "I'll be honest; I haven't done a very good job of networking with other people [outside of my implementation team] that much. I think this year we talked about it more, so from here forward maybe." Another mentor thought her role should be more restricted to offering advice and being open to those who approach her for questions but not so much in a way of being a liaison to connect members or to seek out to other mentors. "I think for me it's more of me being open to other people coming to me with questions, than me going to other people within the network to get my questions answered." Such differences, and in some ways conflicting, in how mentors view their role and the scope of their influence is intriguing. This also raises questions about whether defining a clearer structure and role definition of mentors is necessary for standardized purposes or perhaps leaving it up to individual mentors to practice at will is a challenge that the network leadership should discuss. The comment below from a design team shows how there are more questions about mentors than who they are and how they influence CoPs in TWIN-CS.

In designing support systems, in bringing people together. We've had mentors do some webinars. What else could the mentors be doing? What could the mentors be doing as a team of mentors? Is there a research project they could be engaged in? Because they're all university-related people for the most part. They spending the outcome or could they be the people who are responsible for assessing and measuring the outcomes? Is this making the school a more effective school?

Theme 4: Principals play a critical role in promoting productive CoPs by retaining regular connection with other principals and influencing their teachers' network activities

Aside from the BC design team, network analysis results showed principals with the strongest average degree (number of direct paths to other network members) and betweenness (brokering tendency between subgroups) measures and had comparable closeness (easily reachable or easy to reach others) with the mentors. While the scope of proactivity and brokering varied individually among mentors (Theme 3), principals, as a group, had a much more consistent pattern of connecting among themselves across the network and with teachers in their implementation teams. Interview data results on principals' roles were consistent with the findings from the network analysis and augmented the overall analysis of Research Question 3. As I examined the interview data, two commonly recurring patterns emerged: (a) principals tended to directly engage among themselves to share knowledge, experience, and learn about implementing TWI, and (b) showed potential to be great influencers to strengthen their teachers' network activities. Theme 4 is a summary of this pattern analysis.

Principals directly engage among themselves to share knowledge, experience, and learn about implementing TWI

"Principals are connecting. They are comfortable with one another." One design team member had no reservations in sharing this observation during an interview in July of 2015. This design team member, who routinely communicates with TWIN principals, also shared some observations made throughout the 2014-2015 school year. She felt confident about the level of their engagement and it progressively improved. She stated, "[More and more, the principals] are checking in [with] each other. They are bouncing ideas off of each other and walk away with a whole new perspective. They feel refreshed and connected."

This pattern of "bouncing off ideas" was evident from interviews with the principals. One principal spoke about how she connected with other principals to learn about how they are implementing their curriculums or the TWI models. She stated,

I spent a lot of time with other principals checking out, "what curriculum works for you? What are you using?" [These conversations] were crucial because trying to find people who are doing the 50/50 model [as a standalone school] is tough, [whereas in TWIN] it helped us by talking through "Okay, how do you run your 50/50?" It helped clarify what we thought made sense as administrators. A lot of the communication was about programming the dual immersion so that it would have a good chance of being successful."

Another principal also shared her learning experience from other principals. In her case, she specifically felt the support from other principals in getting her acquainted with the Woodcock-Munoz assessment data and said,

[I am] learning from other principals and their [implementation] teams. I am not advanced in doing the data stuff myself. But they can talk to me about data. It gets my brain around it. I am not going to be some data expert but at least I am going to be able to utilize this connection to drive our program.

I also found some evidence of principals reaching out to other principals to help make TWI implementation decisions or to benchmark and adapt practices. One principal shared how she connected with another principal to help make a decision. "[This past year], I reached out to another principal, in terms of helping [principal's name] decide on a few things about the Spanish curriculum and textbook selections. There were also instances in which principals would proactively reach out to others and encourage them to share and adapt knowledge and tools needed for TWI implementation. In her brief narrative, she said,

This principal told me the other day, she said she wanted to reach out to me [during the year] but she didn't want me to think, or the network to think, that she was just copying another school. But I said, "wait, no, you should be copying, I want to copy you, whatever you're doing well, we need to share it."

One principal spoke about an interest to serve as an informal mentor for other network schools that are just joining and emerging in their TWI models. "Why couldn't we be paired up as a mentor school to an emerging school?" This principal said. She also "I would be more than happy to build stronger bonds with that principal, stay in touch with that principal, make sure they are doing ok, see if I could be of any help." She also mentioned her willingness to take on this additional mentor role but also suggested that the network could benefit by providing such guideline for principals of the advanced schools. She said,

It would have been really nice for me [several years ago] when I was by myself starting. I'm thinking maybe [what] the network could do is say, "hey [school name], would you be willing to support St. Blah Blah and would you do the following?" Then I'd go do it. I swear.

Influencing teachers by assisting them to strengthening their network activities

Another common pattern that emerged about the principal's role in promoting productive CoPs is that they saw themselves as potential (or for some already are working on)

influencers for the teachers to strengthen their network activities. Earlier in this Theme 4 section, I pointed out that principals tend to have strong connections with their implementation team members. Moreover, the core-and-periphery network structure (RQ2) and the analysis of Theme 2 (RQ3) showed the disconnect between teachers and the other network members. Thus I examined the interview data to seek any evidence of principals' role in promoting teachers' network activities. All four principal interviewees spoke to some degree about how they were, or planning to, promote stronger teacher engagements. On the other hand, teacher interviewees rarely spoke of their, or other, principals at all.

Principals, for the most part, spoke about providing some form of structure or mandate to get their teachers engaged in the network activities. One principal shared her thoughts about providing some information and guide to improve teacher connectivity.

I think until [teachers] have a personal connection with [other TWIN teachers from other schools], they wouldn't think too much about connecting. I know we have information that can help them reach out and I would really like to help strengthen the ties between teachers.

Another principal took a step further and thought some form of enforcement would be necessary. She said,

One of the things I have found is the lack of teachers connecting to one another across the network. Unless we figure a way to have them do it, they are not going to do it [voluntarily]. I am going to [enforce] some mandate that teachers check into the TWIN network on a regular basis. I am going to do it by email and I am going to ask for evidence that they've done so. I think it's the only way we can get connected. I know this may sound a little, dictatorial or whatever, but we all know each other [in TWIN-CS] and I know how this works.

Similarly, a principal from another school explained how she "pushed" her teachers to become better at administering the language assessments (Woodcock-Munoz) and expand their comfort level as consumers of the data-driven results by revisiting archived data at the TWIN-CS website and past webinars. She said,

I've got teachers who are not any more advanced in [consuming data-driven results] than myself. So to I challenged them, "Okay, I have the Woodcock, I have the spring data," and just pushed them. I pushed them to re-train themselves [from past workshops] and webinars. We need to see how to do this thing again.

There was also evidence of some initiative from the principals to proactively play a broker role to connect her teachers with a mentor from another network school when she felt that mentor could provide address some helpful content expertise in reading development.

In our early [TWIN] stages, teachers were feeling lost in the guided reading for [TWI language]. I would tell my teachers, I am going to get [a substitute] for your class time, and you guys are going to have this hour to talk to [mentor's name] and discuss plans for [TWI language] reading development plans.

At the time of the data collection, I found no evidence about how these plans, or proposed plans, by the principals have actually panned out for the teachers. As mentioned earlier, teacher interviewees unanimously did not mention about their principal's role or intervention about their network engagement, as opposed to sharing their engagement with their mentors or seeking for prospective connection with other teachers across the network.

Chapter Summary

The network survey yielded a 75% response rate. Although the overall response rate was in the lower threshold for a network survey, I did not impute missing data since the purpose of the survey was part of a case study and the systematic nature of missing data (only from the teacher group) suggested that missing responses likely came from members with low TWI activities in the network.

Quantitative results for Research Question 2 revealed that TWIN-CS has a core-andperiphery network structure with the Boston College design team at the innermost core, with visibly dense ties connecting to and from them. Most teachers, on the other hand, occupy the most peripheral positions in this network. Survey evidence also showed that participants generally perceived a much stronger learning relationship within schools and showed less certainty on cross-network relationships. In terms of learning characteristics, majority of the respondents viewed knowledge sharing, trust, and advice-oriented dimensions "strongly" but perceived a lack of data-driven learning for both within school and cross-network.

Analysis of the qualitative evidence for Research Question 3 led to four themes highlighting how the roles were perceived in promoting productive CoPs. The four themes were: (a) the design team functions as the central communication hub of TWIN-CS, (b) there is a lack of structured guidance for the teachers to engage in network activities, (c) mentors are proactive influencers but the scope of their influence varies, and (d) principals play a critical role in promoting productive CoPs by retaining regular connection with other principals and influencing their teachers' network activities.

Chapter 6: Discussion and Conclusion

Chapter 6 concludes this dissertation and proceeds in the following order: (a) a brief overview of the research, (b) summary of findings, (c) implications for future research and practices, and (d) limitations of the study.

Research Summary

Current demographic trends in the United States suggest that the CLD student population is rapidly growing (Hernandez, Denton, & McCartney, 2009; Passel & Cohn, 2008). Despite that trend, CLD students' educational needs remain underserved in traditional school settings (Garcia & Cuellar, 2006; Ruiz-de-Velasco & Fix, 2000). Research shows that students participating in the TWI model tend to perform better academically than comparable groups of CLD students not in TWI (Howard & Christian, 2002; Howard & Sugarman, 2007). However, school reform intended to serve CLD students' needs is difficult to come by in a traditional school setting. In particular, teachers are often isolated in their classrooms and, as a result, a private-practice culture prevails (Nieto, 2003; Sindberg, 2011).

TWIN-CS represents a coordinated effort to support school reform by engaging school leaders and teachers collectively in learning how to implement TWI models in their schools. One of my study's most important objectives was to analyze how TWIN CoPs emerged within schools with no history of serving CLD students. I studied the network of educators by investigating the extent to which a relational network of teachers, administrators, TWI mentors, and experts promote productive CoPs that are engaged in implementing and transforming into TWI instructions.

I used a case study design (Yin, 2009) with a bounded unit of analysis that included the implementation teams of the 10 inaugural TWIN schools along with the Boston College design

team. Each implementation team consisted of the school's principal, teachers who taught in TWI classrooms during the 2014–2015 academic year, teachers who were preparing to teach in TWI classrooms starting in the 2015–2016 academic year, and a TWI mentor. Boston College faculty and staff members affiliated with the Lynch School of Education and the Roche Center for Catholic Education comprised the design team. Although the personnel count of the design team has grown since the early stages of TWIN-CS, my definition of the design team only included the two senior leaders from the Roche Center and the two Boston College faculty members who have been a part of the program since its inception. I made this decision because new design team faculty joined TWIN-CS during or after the 2014–2015 school year, which made it difficult to have meaningful interactions with other study participants at the time of data collection. In sum, the study's unit of analysis consisted of 56 participants (34 teachers, 8 principals, 10 mentors, and 4 design team members from 8 schools).

To answer the research questions I designed this research to collect and analyze both qualitative and quantitative data. Qualitative data mostly came from 15 semi-structured interviews of five teachers, four principals, four mentors, and two design team members. Data were collected during the 2015 Summer Academy in Massachusetts with supplementary evidence from TWIN archival data including professional development evaluations, participant feedback, and prior surveys. I obtained all quantitative data from the network survey administered between May and June of 2015, just prior to the Summer Academy. Of the maximum possible responses ($N_{TOT} = 56$), 42 participants submitted valid responses, yielding a final response rate of 75%. A breakdown of the response pattern revealed that 59% of the teachers submitted their surveys while 100% of the respondents from all other groups submitted their questionnaires.

Although this research was not designed to follow a sequential (Quant \rightarrow Qual or Qual \rightarrow Quant) mixing of methodologies, I used centrality measures from the network survey results to inform the development of a few interview questions and interviewee selection. The intent of this purposeful sampling of interviewees was to gather as much narrative evidence from both influential participants (those with high centrality measures: e.g., betweenness or degree) as well as low influencers (isolates or low-degree actors). Unfortunately, most individuals identified under the latter category declined to be interviewed, thus constraining the interview data to originate from individuals with relatively higher levels of engagement in TWIN CoPs.

Summary of Key Findings

Research Question 1

Do the organizational features of TWIN-CS facilitate productive learning among participants implementing TWI models? If so how?

Findings:

- 1. Organizational features are platforms for learning growth and expansion.
- 2. The expansion of CoPs beyond TWIN-CS prompts productive learning.
- 3. TWIN-CS lacks clear internal structures and role definitions.
- 4. Sustained connections are vital for productive learning.

Organizational features as learning platforms. Based on the analysis of individual interviews, I found evidence to suggest that most participants in this study viewed organizational features as helpful in promoting productive learning. Coding for interviewee responses revealed that many thought of the organizational features as platforms to share experience and provide a wealth of knowledge for implementing TWI models at their schools. Many also agreed that

webinars and the Summer Academy were two of the most crucial organizational features facilitating their learning and that the TWIN-CS website and the design team served as channels of knowledge and content resources.

Overall, principals and mentors showed a tendency to interact and pick up new knowledge from other principals and mentors, and they actively reached out to the design team throughout the school year. Mentors also tended to challenge their implementation teams to collectively think deeper and resolve problems by incorporating resource and knowledge obtained through webinars and the Academy.

On the other hand, I did not find explicit evidence of teachers speaking about learning new ideas by challenging each other to solve problems by using webinars and the Academy. Although they spoke of the importance of the organizational features, teachers held more passive views toward engaging in learning to implement TWI. Throughout the data collection stage, several teacher participants showed reluctance toward participating in the survey and interviews. In Chapter 1 I discussed the issues of teacher isolation in classrooms (Rasberry & Mahajan, 2008; Sagor, 1992; Sindberg, 2011). Nieto (2003) argued that teachers spend much of their time in isolation with students in their classroom without much interaction with their colleagues. Analysis of teacher interviews confirmed my research findings about the prevalence of isolated teaching practices at that analysis stage.

Productivity in the context of TWIN CoP. Discovering what makes productive learning and how the participants practice such productivity in TWIN-CS were important discussions for Research Question 1. My examination of the interview data revealed three important means of productivity in TWIN CoPs: (a) CoP expansion beyond the bounds of

TWIN-CS, (b) a need to define a purposeful connection, and (c) sustaining network connections throughout the school year.

An intriguing finding from the interview data was that many participants were reaching out beyond TWIN-CS to communicate and benchmark other schools' dual-language models. Such expansion of CoPs beyond TWIN-CS ranged anywhere from informal acquaintances with other local school leaders to a more formal partnership of sharing knowledge and resources. As noted earlier in this study, Wenger (2011) stated that CoPs are not limited by formal structures but create connections among people across organizational structures or geographic boundaries. One principal described her practices that extend beyond TWIN-CS: "If I'm lost in something, I will find somebody who's very close, like a neighboring public dual-language school, or somebody I already know . . . that could be really helpful." Evidently, several members' engagement beyond TWIN-CS confirms Wenger's theory of "unbounded CoPs"; that is, their non-TWIN activities result in CoPs because the members are mutually engaged in a common domain of interest with the goal of sharing and contributing knowledge to that enterprise, all of which are indicators of CoP (Wenger, 1999).

Several participants mentioned the need for defining a purposeful connection in the network. Their comments during the interview may fuel the start of a reform of the current TWIN-CS network structure. With the exception of the Summer Academy and webinars, evidence from the interviews clearly suggests the absence of a robust internal structure to promote additional productivity. One member mentioned the need to establish why members connect in the first place, because that would promote meaningful and sustainable connections between individual members and the implementation teams.

The majority of members thought that sustaining connections throughout the school year was extremely important. However, mostly due to budget constraints, TWIN participants faced a great challenge in sustaining their connections beyond the Summer Academy. Still, it is difficult to argue against the value of face-to-face interactions. A principal and a teacher suggested additional regional meetings, but they also expressed concerns that such meetings "may be a reach" or "may not work." Perhaps financial constraints make it difficult to hold additional inperson meetings, but it is worth considering piloting additional meetings in at least one region or developing additional interactive online opportunities to supplement webinars.

Qualitative findings for Research Question 1 can be tied to Klein and Connell's (2008) framing of the knowledge activity classifications within CoPs (see Table 2.3). In their knowledge classification, Klein and Connell (2008) suggested that CoPs are not confined to one of the four categories. For example, knowledge-sharing CoPs may seek to develop and maintain a more structured body of knowledge, but knowledge-nurturing CoPs would feature less structure, allowing members to freely develop, interpret, and understand their communities' learning goals. Evidence from interview data shows that TWIN-CS members practicing CoPs were looking forward to formulating more internal structures and role definitions, yet many ventured beyond the bounds of the network to engage in learning to implement TWI, which was consistent with this theory.

Research Question 2

What are the characteristics of relational networks among participants in TWIN-CS?

Network Characteristics. To understand the characteristics of TWIN-CS network structure, I asked the participants to identify their relationships with other members in the context of "implementing TWI" throughout the 2014-2015 school year. The three network

questions asked in the survey were: (a) "Who (if anyone) did you talk to about implementing the TWI model?" (Communication Network), (b) "...*seek general advice* about implementing a TWI model?" (Advice Network), and (c) "...*ask specific questions* about implementing a TWI model?" (Question Network).

Analysis of the network characteristics revealed two distinctive traits of TWIN-CS: that the network has a core-and-periphery structure (Borgatti & Everett, 2000) and a dense communication hub formulating around the design team. In particular, the communication and question networks showed that the design team occupied the innermost-core with dense connections between mentors and principals, who occupied the outer-core layers. On the contrary, teachers were positioned on the outer periphery of the networks.

Research shows such core/periphery structure is rather common in networks representing social or economic issues and there is a positive correlation between centrality and various measures, such as academic performance or job promotions (Hojman & Szeidl, 2008). Although TWIN-CS does not have economic or social performance implications, distinct positionalities by different roles in the network were consistent with the arguments by Hojman and Szeidl (2008). To further examine *why* and *how* such structure evolved in TWIN-CS, I used this quantitative evidence to develop specific questions in the interview protocol to gather qualitative evidence to support the survey findings. More discussion about this issue follow in the next section.

Unlike the communication and question networks, the advice network displayed a less distinct core-and-periphery structure. Instead, I observed a clustered communication pattern with signs of cross-school advice seeking among the teachers. This was a bit surprising given that seeking advice and questions, although not exactly having the same meaning, can be thought to be closer to each other in practice than having general communications. The former has one person seeking out another person to receive information while general communication could be any form of dialogue exchanged with respect to TWI implementation.

Based on the results from the other two networks' core-and-periphery structure, I expected the advice network to follow a similar trend with the core members likely being the design team and mentors who are content experts. Another unique feature of the advice network was that mentors were not positioned in a core hub or sub-hubs with strong in-degrees (receiving advice inquiries), but they were relatively scattered throughout the network and sought general advice from other members (including teachers), while sharing their advisor role with principals as shown in Figure 6.2, (3).

Figure 6.1 illustrates core structures of the three networks in this study. The top two graphs represent cores of the communication and question networks while the bottom represents core of the advice network. As these partial sociogram illustrate, the advice network has two groups of actors with central tendencies, one of which comprising the design team (enclosed in red dotted line) and the other group with some principals and mentors (enclosed inside solid blue area), and several mentors and principals are deviating or detached from the core. This is a noticeable contrast to the clearly visible core-and-periphery structures, with dense inner (design team) and outer-core layers (mentors and principals) in the other two networks in Figure 6.1.

The advice network structure closely resembles the ideal CoPs within TWIN-CS. Rather than having a high reliance on the design team, who essentially played a "super hub" in Figure 6.1, and a clear divide between teachers and non-teachers, the advice network has two distinct groups who share central roles with several sub-hubs connected to these groups.



(3) Advice Network

Figure 6.1. Core Representations of the Communication, Question, and Advice Networks
Furthermore, evidence of direct cross-school communication, irrespective of their roles,
poses another positive sign in terms of communication efficiency and diverse network
functionality. Part of what TWIN-CS seeks to promote is less dependency on certain groups or
individuals with loosely defined sub-hubs that are engaged within and across schools (TWIN-CS
Executive Summary, 2015).

With density measuring less than 10% for all three networks, TWIN-CS is considered a low density network (Borgatti et al., 2013). Density is defined as the proportion of the total number of connections observed in a network by the total number of connections possible. The

higher the density, the more nodes are connected; I can interpret that as highly engaged in learning to implement TWI models through specific questions and answers among members. The communication network (9.4%) had a higher density measure than the advice (3.8%) and question (5.1%) networks. Notice the low density measure of the advice network compared to the other two networks. A lower density measure means less connectivity and network activity, suggesting the advice network has far fewer relational data points to be observed. That leads to the plausible speculation that the deviating network structure may have happened by chance.

Consistent with the findings from the network structures, I observed a substantial gap between the design team with high degree measures (count of connections) and the principals, mentors, and teachers. In all three networks the principals tended to have higher out-degrees while mentors had higher in-degree measures. Intuitively, that shows principals are more engaged in reaching out to other members in the network while the mentors tend to receive more inquiries or communication requests from the others. Although teachers had the lowest degree measures among the groups, the differences were far closer among those three groups compared to the design team. The closeness measure (an actor's position relative to all other actors) also showed a similar pattern with degree centrality but with less of a gap between the design team and the rest.

Unlike degree and closeness centralities – where the measures were relatively close and the differences were not as pronounced among principals, mentors, and teachers – I found a clear ranking of the strength of betweenness (broker role) in the order of the design team, principals, mentors, and teachers. It is intriguing to note that the principals, particularly in the advice and question networks, played a relatively strong broker role. In the case of the advice network, the principals (75.1), on average, were only about 15 units lower than the design team (90.2)

whereas the overall network's standard deviation was 60.8. This is consistent with the network structure discussion from earlier; the core-and-periphery structure of the advice network was less prevalent, and I found evidence of the elevated presence of principals in the question network as they connected across the core layers and between members.

My analysis of the survey data also revealed that participants generally perceived a much stronger learning relationship within their implementation teams, but they were less certain on intra-network relationships. In terms of learning characteristics, the majority of respondents took a strong view toward knowledge sharing, trust, and advice-oriented dimensions but perceived a lack of research-based and data-driven learning, both within the school and crossnetwork.

Research-based and data-driven CoPs are the most plausible immediate next steps for research. During the data collection and analysis stage for this dissertation study, the design team was working on collecting and tracking TWIN-CS students' language performances across waves of testing since joining the network. Such longitudinal language test results can provide valuable information for school leaders to assess their TWI implementation models. Such test results also create a new avenue for research mapping student achievement with educators' CoPs.

Research Question 3

How are the individuals' roles associated with promoting a perceived productivity within communities of practice in implementing a TWI model?

Findings:

- 1. The design team functions as the central communication hub of TWIN-CS.
- 2. There is a lack of structured guidance for the teachers to engage in network activities.

- 3. Mentors are proactive influencers with varying scope of influence.
- 4. Principals play a critical role in promoting productive CoPs by retaining regular connection with other principals and influencing their teachers' network activities.

Design team. Interview data showed the design team's positive influence on the network as advisors who trigger new thoughts while conducting and disseminating research findings for informed TWI implementation. The design team also played a critical role as administrators, planning and promoting network growth and sustainability. As the network grew rapidly, however, there was evidence of prevailing members' perceptions that the design team's current leadership model was becoming less effective because individual design team members were being overwhelmed by increased workloads. Inevitably, transforming the design team's role became crucial, and initial thoughts from the design team suggested redistributing some leadership to other experienced schools or individual network members.

Teachers. Based on the analysis of the interview codes and recurring themes from previous research questions, teachers expressed that the lack of a mandate system and overwhelming daily tasks may have inhibited their network participation. It was evident that teachers were looking forward to promoting productive learning by engaging in more opportunities to connect among themselves. The primary interest in more teacher connections was to allow teachers to share their experiences in teaching and associating with parents.

Despite the evidence pointing toward such motivation, however, teachers were often overwhelmed with daily tasks at their schools that took priority over network activities. A few teachers launched some initiatives to connect and help improve classroom practices, but those efforts were largely localized and isolated within implementation teams. In an effort to expand their connection across network, a mandated check-in system may be necessary for the teachers to connect regularly.

Research has shown that the practice of teaching and student learning outcomes are strengthened through collective questioning of ineffective teaching routines, seeking new and creative ways of teaching and learning, and actively engaging in supporting one another's professional growth (Darling-Hammond et al., 2009; Grossman, Wineburg, & Woolworth, 2001; McLaughlin & Talbert, 2001; Stokes, 2001). Based on the teacher interviews, the evidence indicates that individual teachers were seeking ways to engage more often with other teachers, but traditional teaching duties and other inhibitors deterred those efforts.

Mentors. Mentors seemed to be proactive in offering advice and, for the most part, played a liaison role in connecting teachers and principals within implementation teams and across TWIN-CS. On one hand, mentors are in a unique position with their research expertise and availability to engage in face-to-face conversations, which are strong benefits that neither the design team nor the principals can offer. On the other hand, proactivity, initiative, and research liaison roles appeared to have different interpretations among individual mentors. Much of the difference in interpretations of the mentor's role can be attributed to a lack of a clear role definition. However, it is unclear whether enforcing a standardized mentor role definition would be beneficial to the network as a whole.

Principals. Examining the interview data led me to find two common trends of the principals' role in promoting TWIN CoPs. First, the principals were actively engaging among themselves to share knowledge and experience and to encourage others to adapt helpful practices. Moreover, at least one principal spoke of her interest in taking on an informal mentor role for emerging member schools by sharing her school's early struggles and how she overcame

them. Secondly, all four principal interviewees saw the need to influence their teachers' network activities. Some spoke about the need for a mandated system to have their teachers connect with teachers from other schools or to retrain through archived features such as the TWIN-CS website or webinars. Other principals played more of the role of brokers who built bridges to connect their teachers with mentors or teachers from other network schools to enhance their learning of TWI curriculum implementation. Finally, however, it was interesting to observe that no teacher interviewee mentioned their principal's involvement in promoting their network engagement.

Role summary. Circling back to Montague's (1997) research, I found evidence of the practice and the need for applying the four critical approaches for successful TWI implementation. First, there was evidence of gradually phasing the dual-language model in as the design team augmented the research efforts by phasing in student language achievement data to inform the next stages of TWI implementation. Second, the design team, mentors, and principals proactively shared knowledge and communicated to ensure that they served as high-quality learning resources. Third, network principals proactively engaged in connecting with other members of the network as well as other school leaders beyond the network to promote productive learning in implementing TWI. Lastly, teacher interviewees were committed to enhancing their professional development in dual-language education, but systematic challenges posed barriers that deterred their active engagements.

Implications

Implication for Practice

Findings from this study could inform members of TWIN-CS to improve learning practices. For example, evidence from this study indicates that there is a lack of a system that would enable teachers to engage more on TWI learning activities. Developing a more inclusive system for the teachers is critical for the successful growth of TWIN-CS because the teachers are at the frontline influencing CLD students. This study was the first comprehensive assessment of the state of TWIN-CS, and the evaluation results may serve as a way for the design team leaders to make evidence-based decisions in steering the network's direction.

This study can also facilitate network-based educational transformation to serve the needs of changing dynamics in educational communities. Beyond the scope of educating CLD students and Catholic schools, this study presents a case study off network-based reform on a domain of interest (learning to implement TWI models). As many studies have suggested, isolated practice still prevails in the education sector (Nieto, 2003; Rasberry & Mahajan, 2008; Sagor, 1992; Sindberg, 2011). Collaboration among educators can happen in multiple shapes, forms, or domains of interest, and while this study may not directly apply to all such practices, TWIN CoPs findings can still serve as a resource for benchmarking future endeavors.

Catholic school education is another area this study can inform. Historically, Catholic schools have underserved CLD students' educational needs (Scanlan & Zehrback, 2010). TWIN-CS is the first national network of Catholic schools to formulate a relational network of educators, researchers, and practitioners to formulate an agenda to advocate productive CoPs and to authenticate sound service delivery models for CLD students. Many stand-alone Catholic schools lack financial and personnel resources, and the unique status of TWIN-CS at the intersection of Catholic education and serving the needs of CLD students can inform Catholic school leaders.

Implication Future Research and Policy

One of the important objectives of this dissertation study was to analyze how TWIN CoPs emerged within schools with no history of serving the CLD students in their communities. Findings from this study can speak to issues of school transformation in the context of capacitybuilding or implementing new curricular models to meet the needs of changing student demographics.

My findings in this study almost exclusively focus on the extent of TWIN participants' roles and their association in learning to implement TWI models. In many communities of practice, however, reifications often promote members' participation in CoPs (Scanlan et al., 2016). Since my dissertation study does not examine the implication of reifications of TWIN CoPs, further investigation of what the members actually do and the structures that facilitate this participation could become a future research question to augment the findings of this study.

Although this current research employed a bounded case study methodology, additional research designs such as a quasi-experimental approach to investigate the level of intervention of a network-based CoP versus a non-network-based program could be employed. Additionally, longitudinal tracking of specific professional development activities may be plausible research topics. For example, teachers in this study generally were marginalized in their level of engagement; future studies may examine the effect of organizational transformation or new professional development activities intended to allow a more inclusive environment for teacher participation.

This research study could be replicated with a redefined unit of analysis. Since the 2014–2015 school year, TWIN-CS has more than doubled its number of participating schools and member counts, and more content experts have joined the original Boston College design team. One interesting research question would be to examine the growth of TWIN-CS and how the findings of this study have (or have not) influenced its growth.

In this prospective study, the network survey could include additional design features to weigh the value of connections beyond their communication frequencies. Strong centrality measures of a member provide only partial evidence of the extent of that individual's level of engagement in TWIN-CS. To measure the strength of the importance of each connection, additional survey questionnaires must be added. These items can ask respondents to select predefined conversation categories, which can be weighted by the researcher, and map these responses to the frequencies and centrality measures to quantify the strength of value that each connection carries.

This study may also have policy implications. Garcia, Jensen, and Scribner (2009) suggested that school improvement to address the needs of CLD students takes time, and they call for a high-level of collaboration to achieve better results. Their argument extends beyond the bounds of school leaders and teachers to call for a collective effort among policy makers, educational researchers and practitioners, government agencies, and nonprofits. At such levels of collaboration, state officials may offer more school funding to implement CLD instructional models while local governments can develop strategies for more effective implementation. Although the number of schools offering TWI models has been on the rise over the past two decades, many states currently regulate or ban the use of that educational model from its public schools. Despite the limit on this study's design as a case study of a Catholic school network, findings of the CoPs in this network may serve as one layer of validation for people with a vision for improving the educational service for CLD students through robust networks of CoPs.

Limitations of the Study

One limitation of this study is that the participants were a self-selected group of educators. The participants took the trouble to go through an application process to join the

network so, at least at the implementation team level, the participants had an established interest in being a part of TWIN-CS. However, because this research aimed to explore CoPs within TWIN-CS by using a case study methodology, any implications from this dissertation should not be interpreted as causal relationships or be generalized to a greater population.

The qualitative component of this study also has some challenges. For example, all 15 interviewees considered themselves to be active participants of TWI conversations and implementation activities. My original intent was to include those participants who were less engaged in TWIN activities or those who did not submit the network survey, but targeted interviewees with such characteristics all declined to be interviewed. Interviews with such members may have presented stronger qualitative evidence about any inhibitors or challenges of participating in CoPs. In addition, because most interviewees were active members in the network, they may have presented a more positively biased vision of TWIN-CS.

Another limitation of this study is my professional tie to TWIN-CS. As a graduate research assistant for the Roche Center at Boston College where TWIN-CS is based, I have been a part of the program since its inception in 2012. As a major stakeholder, the Roche Center has a strong interest in the results of this case study, which also will serve as an evaluation report for TWIN-CS. Throughout my 4 years as a graduate assistant for the program, I have formed professional relationships with most participants in this study. As a result, some bias exists on my part as researcher in reviewing, interpreting, and analyzing the results of TWI CoPs. In order to mitigate that bias, I made it clear to the participants that responses to the survey and interviews were purely voluntary, and every participant signed the consent form. Participants were also clearly informed that the results would not be used in any way as performance evaluations; rather they were intended to serve as part of an exploratory study to provide empirical evidence to

better determine the direction of TWIN-CS.

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Appendix A: Network Survey

Q1.1 Please select your school affiliation from the drop-down menu:

- O All Souls (12)
- Archbishop Borders (13)
- O Boston College Roche Design Team (24)
- O Juan Diego Academy Holy Rosary (14)
- O Most Holy Redeemer (15)
- Notre Dame Primary (16)
- O Risen Christ (18)
- St. Leo the Great (20)
- O St. Mary Magdalen (21)
- O St. Mary's (22)
- O St. Matthew (23)

Q1.2 Please indicate your role:

- **O** Principal / Headmaster / President (1)
- **O** Assistant / Vice Principal (9)
- Teacher / Faculty (2)
- O Mentor (5)
- O BC Roche Design Team (13)
- O Other: (specify) (6) _____

Q1.3 Please select your name from the drop-down menu:

- O Principal (13)
- O Mentor (14)
- O Teacher 1 (15)
- **O** Teacher 2 (16)
- **O** Teacher 3 (17)
- **O** Teacher 4 (18)
- **O** Teacher 5 (19)

Q1.4 Please select your name from the drop-down menu:

- Principal (14)
- O Mentor (15)
- O Teacher 1 (16)
- **O** Teacher 2 (17)
- **O** Teacher 3 (18)

(*Note that the list below is anonymized. The actual survey included real names of the participants and their roles)

- 1.5 Please select your name from the drop-down menu:
- O Design Team 1 (14)
- O Design Team 2 (15)
- O Design Team 3 (16)
- O Design Team 4 (17)

Q1.6 Please select your name from the drop-down menu:

- O Principal (14)
- O Mentor (15)
- Teacher 1 (16)
- Teacher 2 (17)
- Teacher 3 (21)
- **O** Teacher 4 (22)
- Teacher 5 (23)

Q1.7 Please select your name from the drop-down menu:

- Principal (14)
- O Mentor (15)
- O Teacher 1 (16)
- Teacher 2 (19)
- Teacher 3 (17)
- Teacher 4 (18)
- **O** Teacher 5 (20)
- **O** Teacher 6 (21)

Q1.8 Please select your name from the drop-down menu:

- Principal (14)
- O Mentor (15)
- Teacher 1 (16)
- Teacher 2 (17)
- O Teacher 3 (18)

Q1.9 Please select your name from the drop-down menu:

- Principal (14)
- O Mentor (15)
- Teacher 1 (16)
- Teacher 2 (17)
- Teacher 3 (18)

(*Note that the list below is anonymized. The actual survey included real names of the participants and their roles)

- Q1.10 Please select your name from the drop-down menu:
- O Principal (14)
- O Mentor (16)
- **O** Teacher 1 (17)
- Teacher 2 (19)
- **O** Teacher 3 (18)
- **O** Teacher 4 (20)

Q1.11 Please select your name from the drop-down menu:

- Principal (18)
- O Mentor (19)
- **O** Teacher 1 (20)
- **O** Teacher 2 (21)
- **O** Teacher 3 (22)

Q1.12 Please select your name from the drop-down menu:

- Principal (20)
- O Mentor (21)
- **O** Teacher 1 (22)
- Teacher 2 (23)

Q1.13 Please select your name from the drop-down menu:

- Principal (14)
- O Mentor (15)
- **O** Teacher 1 (16)
- **O** Teacher 2 (20)
- **O** Teacher 3 (17)
- **O** Teacher 4 (18)
- Teacher 5 (19)

(*Note that the list below is anonymized. The actual survey included real names of the participants and their roles)

Q2.1 Section I. Background Information. The following questions are about your basic demographic information as well as experience and views on Two-Way Immersion (TWI) model.

- Q2.2 Are you female or male?
- Female (1)
- **O** Male (2)

Q2.3 What is the highest level of formal education you have completed?

- O High school and/or some college courses (1)
- Associate's degree (2)
- **O** Bachelor's degree (3)
- Master's degree (M.Ed., Ed.M., M.A., M.S., M.P.P., M.P.A., M.B.A., M.S.W., M.Div., M.Eng., M.Phil, LL.M.) (4)
- O Doctoral degree or equivalent (Ph.D., Ed.D., M.D., J.D., Psy.D.) (5)
- Q2.4 What is your current employment status as a teacher?
- Full-time (1)
- Part-time (2)
- Q2.5 What is your current employment status as a principal?
- Full-time without teaching obligation (1)
- Full-time with teaching obligations (3)
- **O** Part-time without teaching obligations (4)
- **O** Part-time with teaching obligations (2)

Q2.6 Please check the grade levels that you are currently teaching. You may select more than one option if you teach more than one grade level.

- Pre-K (7)
- Kindergarten (8)
- 1st grade (9)
- 2nd grade (10)
- □ 3rd grade (11)
- □ 4th grade (12)
- **5**th grade (13)
- Other: please specify (14) _____

Q2.7 Did you complete a bilingual education training program or certificate?

- O Yes (1)
- O No (2)
- O Other: Please specify your circumstances: (3) _____

	Minimal (1)	Fair (2)	Good (3)	Strong (4)	I'm Not Sure (5)
Curriculum (4)	0	0	0	0	0
Teaching (5)	0	0	0	0	0
Standards (11)	0	0	0	0	0
Summative Language Assessment (e.g. Woodcock- Munoz or BVAT) (7)	O	0	0	0	O
Achievement Tests (e.g. SAT- 10 or ITBS) (8)	0	0	0	0	0
Formative Assessment (9)	•	•	•	•	О

Q2.8 How knowledgeable do you feel about the following attributes in a TWI model?

Q2.9 How many years of work experience do you have? Please type in your response rounded up to whole number of years.

Year(s) working as a teacher in TOTAL (2) Year(s) working as a teacher at your CURRENT school (4) Year(s) working as a teacher in a BILINGUAL program (5)

Q2.10 How many years of work experience do you have? Please type in your response rounded up to whole number of years.

Year(s) working as a principal in TOTAL (2)

Year(s) working as a principal at your CURRENT school (4)

Year(s) working as a principal in a BILINGUAL program (5)

Q2.11 How many years of work experience do you have? Please type in your response rounded up to whole number of years.

Year(s) working as a mentor for your CURRENT school (4)

Year(s) working as an academic or professional for a BILINGUAL program (5)

	Strongly Disagree (1)	Somewhat Disagree (2)	Somewhat Agree (4)	Strongly Agree (5)	l'm Not Sure (6)
I find such people within my own school (1)	0	0	0	0	0
I find such people outside of my school but within TWIN-CS (2)	0	0	0	0	O
I find such people outside of TWIN-CS (3)	0	0	0	0	0

Q2.12 When I am looking for people with expertise in implementing the TWI model...

Q2.13 Section II. Now we have a few questions about how you interact with others in implementing the Two-Way Immersion (TWI) model

Q2.14 During the past school year (2014-2015), who (if anyone) did you talk to about implementing the TWI model? (*Note that the list below is anonymized. The actual survey included real names of the participants and their roles)

School A

- Principal (13)
- O Mentor (14)
- O Teacher 1 (15)
- Teacher 2 (16)
- O Teacher 3 (17)
- O Teacher 4 (18)
- O Teacher 5 (19)

School B

- Principal (14)
- O Mentor (15)
- O Teacher 1 (16)
- O Teacher 2 (17)
- O Teacher 3 (18)

Boston College Design Team

- O Design Team 1 (14)
- O Design Team 2 (15)
- O Design Team 3 (16)
- O Design Team 4 (17)

School C

- O Principal (14)
- O Mentor (15)
- O Teacher 1 (16)
- **O** Teacher 2 (17)
- O Teacher 3 (21)
- **O** Teacher 4 (22)
- **O** Teacher 5 (23)

School D

- Principal (14)
- O Mentor (15)
- O Teacher 1 (16)
- **O** Teacher 2 (19)
- **O** Teacher 3 (17)
- **O** Teacher 4 (18)

- Teacher 5 (20)
- O Teacher 6 (21)

School E

- O Principal (14)
- O Mentor (15)
- **O** Teacher 1 (16)
- Teacher 2 (17)
- **O** Teacher 3 (18)

School F

- Principal (14)
- O Mentor (15)
- Teacher 1 (16)
- **O** Teacher 2 (17)
- Teacher 3 (18)

School G

- O Principal (14)
- O Mentor (16)
- O Teacher 1 (17)
- Teacher 2 (19)
- O Teacher 3 (18)
- Teacher 4 (20)

School H

- Principal (18)
- O Mentor (19)
- Teacher 1 (20)
- Teacher 2 (21)
- Teacher 3 (22)

School I

- Principal (20)
- O Mentor (21)
- Teacher 1 (22)
- Teacher 2 (23)

School J

- O Principal (14)
- Mentor (15)

- O Teacher 1 (16)
- **O** Teacher 2 (20)
- **O** Teacher 3 (17)
- **O** Teacher 4 (18)
- **O** Teacher 5 (19)

Q2.15 How often do you talk to the following colleagues about implementing the TWI model?

Names Listed	Less than once per semester (1)	Once or twice per semester (2)	Once or twice per month (3)	Once or twice per week (4)	More than twice per week (5)
	Ο	Ο	Ο	Ο	О

Q2.16 With which staff members do you... [Check all that apply]

Names Listed	Ask specific questions about implementing a TWI model (1)	Seek general advice about implementing a TWI model (2)
	0	0

Q2.17 What kinds of things do you talk about? [Check all that apply]

Names Listed	Teaching challenges in TWI setting	Developing a TWI curriculum	Sharing instructional materials & strategies	Coordinating instruction with one another	Multicultural interaction in classroom	Reference to other resources I can reach out for help	Summative & formative assessment
	Ο	Ο	Ο	Ο	Ο	0	Ο

Q2.18 Section III.

You are almost done! This last section has just few questions about communication within your school and the Network.

Q2.19 What are the primary reasons why you talk to some people and not others about learning to implement a TWI model? [Check all that apply]

- □ Personal relationship/closeness (2)
- Perceived content expertise (I go to people who have a deeper understanding about implementing TWI) (1)
- □ Authority relations (I am required to go to certain individuals) (4)
- □ Anticipation of exchange relationship (I help this individual so he/she will help me) (5)
- □ Has faced similar challenges (They understand my situation from experience) (6)
- Other. Please specify: (8) _____

Q2.20 How would you characterize the relationships among the members of your school's TWI Implementation Team?

	Minimal (1)	Fair (2)	Good (3)	Strong (4)	I'm Not Sure (5)
Trusting (1)	0	0	0	0	0
Advice- oriented (2)	0	0	•	•	•
Knowledge- sharing (3)	•	•	•	•	O
Best practices- oriented (4)	•	0	•	•	o
Data-driven (5)	Ο	Ο	Ο	Ο	Ο

Q2.21 Specifically, how would you describe the level of collaboration within your TWI Implementation Team about learning to implement a TWI model?

- **O** Highly collaborative throughout the Implementation Team (1)
- **O** Strong collaboration exists, but mostly in certain pockets in the Implementation Team (2)
- Variable levels of collaboration exist (some places it is extensive, other places it is nonexistent) (3)
- **O** Low levels of collaboration exist within the Implementation Team (4)

Q2.22 How would you characterize the relationships between your school and other schools in the Network?

	Minimal (1)	Fair (2)	Good (3)	Strong (4)	l'm Not Sure (5)
Trusting (1)	0	0	Ο	0	0
Advice- oriented (2)	0	0	•	0	•
Knowledge- sharing (3)	•	•	•	0	•
Best practices- oriented (4)	0	0	•	0	•
Data-driven (5)	0	0	0	0	0

Q2.23 How would you characterize	he relationships among al	I schools in the Network?
----------------------------------	---------------------------	---------------------------

	Minimal (1)	Fair (2)	Good (3)	Strong (4)	I'm Not Sure (5)
Trusting (1)	Ο	Ο	Ο	Ο	Ο
Advice- oriented (2)	0	0	0	0	О
Knowledge- sharing (3)	0	•	•	0	0
Best practices- oriented (4)	0	•	•	0	O
Data-driven (5)	0	0	0	0	0

Q3: Please click below if you are interested in participating in a 30-minute interview at the Summer Academy (if participating) or by phone. If you are not sure, you can simply move on without clicking the option below.

O Yes, I am interested in participating in the follow up interview (1)

Q4: Please click the SUBMIT button to send away your completed survey. Your responses are NOT complete until you press the SUBMIT button. Please be advised that you will NOT be able to go back to your survey after you have clicked the SUBMIT button.

Appendix B: Interview Protocol

Research Objective

"I'm studying how TWIN-CS teachers, administrators, and mentors learn from one another – in their schools and across the network – to better educate Culturally and Linguistically Diverse students. I'd like to ask you a few questions to get your perspective on this topic."

All Members:

- 1. What are a few words you would use to describe the <u>overall</u> progression of TWIN-CS over the past year as a whole network?
 - a. Probe for <u>specific</u> aspects of TWIN-CS: things they felt were <u>strong</u> and others <u>not so strong</u>.
 - b. If they struggle to think specific examples, provide some lead (webinars, surveys, implementation team meetings, communication with other members in/out of their school).
- 2. Would you characterize the interactions among members of TWIN-CS as productive?
 - a. Probe: How would you grade it on a scale of 1 to 5 (five being excellent, one being not at all)
 - b. Why?
- 3. What are some important things you have learned from and with other TWIN-CS m embers to implement two-way immersion model? (both within school and across the network)
 - a. How?
 - b. Distinguish who they're "learning from" vs "learning with"
- 4. In your view, what are some important activities, processes and materials that our Network has used to promote a robust two-way immersion model in your school?
- 5. ...across the Network?

Only Principals

P1. Can you tell me a story about some challenges you face in implementing the two-way immersion model at your school?

P2. What specific features of collaborative learning among all TWIN-CS members do you think can help address your concerns? Why?

Only Teachers

T1. Can you tell me a story about some challenges you face as a teacher in being an active member of TWIN-CS?

T2. How do you think the teachers can get more involved in collaborative learning among all TWIN-CS members to help address your concerns?

Only Mentors

M1. What are some key challenges you observe from your school's two-way immersion implementation team (in the context of implementing the TWI immersion model)?

M2. How can the current roles of the TWIN mentors be modified or bolstered such that their presence can further strengthen the interaction within the Network?

Only Design Team

D1. Data from the relational network survey suggest that our network has high dependence to the Design Team when it comes to implementing the two-way immersion model. What are some challenges you see as a result of this phenomenon?

D2. How can the Design Team help promote a more efficient flow of information and communication and avoid the bottleneck effect in our network?