

Efficacy, Explore, and Exchange: Studies on Social Side of Teacher Education from England, Spain, and US

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Abstract: This study attempts to respond to a recent call for a more social and collaborative approach to teacher education and professional development by examining the social side of pre-service teachers during preparations from England, Spain and US. We explore core factors that are associated with dyads of pre-service teachers in exchanging instructional materials at the end of a teacher education program from each setting. Using social network selection models, this study investigates the extent to which pre-service teachers' reported self-efficacy, peer trust, innovativeness, and demographic characteristics is associated with the sending, receiving, and reciprocating instructional materials. Findings suggest the important role of self-efficacy and innovativeness in explaining pre-service teachers' seeking behaviors across the study contexts.

Key Words: Pre-service teacher education, social network, peer trust, efficacy, cross-country

Highlights:

1. Self-efficacy is associated with seeking instructional materials from peers across settings
2. Exchanging new ideas plays an important role in seeking materials from peers across settings
3. Peer trust plays a significant role in the seeking behaviors within the English cohort

Introduction

Teacher preparation is critical work that has the potential to significantly impact the quality of education. This important undertaking has become a central conversation both locally and globally. While research scholars commonly believe that teaching is a result of locally situated practice, however, teaching today is inevitably embedded within a larger global context of shared conversation, practice, and even metrics (Paine & Zeichner, 2012). In the face of globalization with rapidly shifts in demography, politics, economy, and technology, international agencies (e.g., World Bank, OECD) play a significant role in framing the work of teachers and teaching and conveying messages about the nature and knowledge of teaching, as well as the preparation and recruitment of teachers (Robertson, 2012). While much of the efforts invested in teacher preparation programs focuses on the human capital development of teachers such as instrumental pedagogical (content) knowledge and skills (Koirala, Davis, & Johnson, 2008; Shulman, 1986), not much efforts in research and preparation programs address the social aspect of teacher development with only a few recent studies underlining its importance (e.g., Oberle & Schonert-Reichl, 2017; Schonert-Reichl, Kitil, & Hanson-Peterson, 2016).

Over the last decade, international reports and cross-national research in teaching and professional learning has called for a more social and collaborative approach to quality teaching (Schleicher, 2016) and improving educational outcomes across different levels of education in various settings (Darling-Hammond, 2017; Organisation for Economic Co-operation and Development [OECD], 2013; The United Nations Educational, Scientific and Cultural Organization

[UNESCO], 2016; Yoon, Yom, Yang, & Liu, 2017). These national and international trends suggest a shift of the educators' work from technical to more social and networked in support of individual and organizational improvement. For instance, classroom teachers with more collaborative ties with their faculty colleagues whose student academic performance tends to be higher than the teachers with fewer ties (Authors et al., 2014; Pil & Leana, 2009). In business organizations, companies that are of greater access to inter-firm connections for exchange of innovative ideas tend to outperform those with limited capital resources (Huggins & Johnston, 2010). This social approach includes the examination of work-related collegial collaboration (Authors et al., 2018), professional relationships that facilitate reform efforts (Coburn, Mata, & Choi, 2013), organizational innovation (Perry-Smith & Mannucci, 2017), and socio-emotional interpersonal relations among educators that support positive work energy (Authors et al., 2016). However, to our search of literature in major educational and social sciences database (e.g., ERIC, Education Index, Education Source, Social Sciences Full Text etc.), there are only a handful of peer-reviewed research articles and one magazine article dated back to the 90s that focus on the social and emotional preparation of pre-service teachers. More so, in practice, a recent national report indicates that only 13% of preparation programs from 304 colleagues of education across the US had one course that offers training around relationship skills and only 2% of the programs offer courses related to social awareness (Schonert-Reichl et al., 2016). The empirical and practical evidence suggests a lack of attention to this social component in teacher education and preparation (Authors et al., 2016).

In terms of policy push, a number of national education policies such as the Common Core State Standards of the United States (US) (Council of Chief State School Officers [CCSSO], 2010) encourage educators to work collaboratively around interdisciplinary teaching. More recently, the England's Blueprint for Self-Improving System (Cruddas, 2015) requires educators to take on a leadership role in collectively developing schools' internal capacity for improvement. Despite the policy demands in these countries, the curriculum and instructional design in teacher preparation

programs has not been fully aligned with the policy directions, as indicated for example by a recent US report (Schonert-Reichl et al., 2016). In moving towards a collaborative model of preparation, more efforts are needed to shed light on the social side of teacher development across the globe.

In addressing the international concern in teacher education, particularly pre-service teacher preparations, we attempt to investigate the social side of teacher preparation in three different contexts: England, Spain, and the US (alphabetical order), as the teacher preparation programs in these countries are of its unique systems and would serve as a set of instructive cases for practical and policy implications. We attempt to explore and characterize the pattern of relationships through the use of social network analysis and key factors that have been identified as critical in individual and collective outcomes such as self-efficacy and peer trust. Specifically, we are interested in investigating the seeking, receiving, and exchanging instructional materials among and between pre-service teachers and the factors that are associated with these ties at each setting. This study is guided by the overarching research question: To what extent are the relationships of sharing instructional materials accounted for by key factors such as self-efficacy and peer trust across settings?

Context

The study contexts are selected largely because they are under similar policy demands that focus on collaborative work of educators and school systems. As pre-service teachers will become in-service teachers to face these challenges, it is imperative to examine the social side of their preparations as a way to provide insight into the design and delivery of training to meet the policy demands.

Teacher Preparation in England

There are a wide range of routes into initial teacher education in England. Each is designed to prepare pre-service teachers to train to teach in primary schools (children aged 4-11 years) and secondary schools (children aged 11-18/19 years). All teachers wanting to teach in schools

maintained by the state need to acquire qualified teacher status (QTS) by demonstrating a range of professional competences associated with the core aspects of teaching and with appropriate personal and professional conduct (DfE, 2011). This can be done by following one of the two major routes to gaining QTS: school-centred programmes or higher education led programmes¹. Higher education led programmes can be part of study for an undergraduate bachelor's degree (normally four years) or a postgraduate programme (normally one year) for pre-service teachers who already hold an undergraduate degree. As well as achieving QTS, the one-year, graduate higher education led programmes usually result in the award of a Postgraduate Certificate of Education (PGCE) equivalent to one third of the study credit required for a master's degree. School-centred programmes tend to only offer one-year, graduate routes to initial teacher education in order to achieve QTS. Some consider the development and growth of school-centred programmes in recent years as a neo-liberal move toward a more market driven approach to training teachers, and possibly a step to diminish the influence of universities in initial teacher education (for a summary see Allen et al., 2016; Mutton, Burn, & Menter, 2017). A number of the schools managing school-centred programmes have continued to partner with universities in order to offer the PGCE qualification in addition to QTS, and that is the case with the pre-service teachers from England in this study.

Teacher Preparation in Spain

The university system in Spain presents two teacher training degrees: The Preschool Education Teacher Training Programme (teachers of 0- to 6-year-old children); and the Primary Education Teacher Training Programme (teachers of 6- to 12-year-old children). The two programmes offer a four-year degree and require training at the university and in-school placement at a local preschool or primary school (on average, 24 weeks). Those who want to teach at a

¹ Key differences between the two main categories are in the way pre-service teachers are recruited and managed on the programme. Both categories of initial teacher education require the same minimum time spent in schools on teaching placements (120 days) and that trainee teachers should gain experience in at least 2 different schools during the programme.

secondary school (12- to - 18-year-old youngsters) must follow a one-year masters' course after obtaining their bachelor's degree. The masters' course also requires a six-week in-school placement during which all pre-service teachers participate in the school activity under the supervision of a schoolteacher who has contact with the professor at the university in charge of the student. The current study context, region of Catalonia, is undergoing a comprehensive school reform driven by social organizations and the Education Administration, which has led to two major initiatives in teacher preparation. The first initiative—Public Agency for the Quality of the University System of Catalonia of 2013— aims to improve teacher training education (MIF Program) by the development of an action-research program involving 10 Universities. The second initiative—the “Escola nova 21” project, led by Jaume Bofill Foundation, UNESCO and Open University of Catalonia, involves 480 schools working together for educational change. Both initiatives have challenged the way in which teacher competencies are defined and developed during preparation programs and called for a shift of teacher role to a more collaborative, interdisciplinary one (Civís, Díaz-Gibson, Fontanet, & López, 2018).

Teacher Preparation in US

Education policy in the US places a great deal of emphasis on the issue of teacher training. This has resulted in the fact that the No Child Left Behind (NCLB) Act of 2001 delineated teacher competences by assessing teachers' pedagogical content knowledge and skills and student performance (Hill & Barth, 2004), and of these competences, knowledge and skills are directly linked to initial teacher preparation. Since then many states offer similar or alternative pathways to certification for prospective teachers. In general, teaching certificates are issued by the states' accredited education agencies (mostly through university-based undergraduate teacher preparation programs with some through teacher pipeline programs of community colleges) for specific or general subject areas and grade levels. Prior to obtaining a teaching certificate, teacher candidates are required to complete a bachelor's degree with coursework tailoring to the subject areas they will

be teaching together with pedagogical knowledge and skills. In addition, these candidates must also complete required practicum or student teaching and pass a series of state level examinations in pedagogy, content knowledge and skills. Despite the pathways to teacher certification, it was not made clear as to the nationwide expectation for quality teachers in terms of the emphasis on social component in teacher education and preparation (Oberle & Schonert-Reichl, 2017), given the international calls for social approach to learning and improvement (OECD, 2013).

Framework

We draw on social network theory to discuss the role of relational ties in individual capital development. We review research literature around core factors that have a hypothesized relationship with the existence of a relational tie including: self-efficacy, peer trust, innovative climate, and gender.

Social Network Theory and Relational Ties

Social network theory is generally concerned with the pattern of relational ties between actors within a network that may support or constrain the accessibility and mobilization of relational resources embedded within sets of actors (Scott, 2000). Central to this notion is the important role of relational ties through which social capital can be developed and accumulated (Kilduff & Tsai, 2003; Lin, 2009). Relational ties between and among actors can be regarded as multiple channels and opportunities in which resources travel across the network from actor to actor for purposive action such as exchange social contacts and useful information for job search (Cross & Borgatti, 2004; Lin, 2009). In turn, actors may benefit from the exchange of resources and as a result develop and/or accumulate their capital asset. This view of social networks and its relationship to social capital is based on the assumption that resources are embedded within relational ties that can be accessed and mobilized to shape social capital (Lin, 2009). Actors with more ties are more likely to quickly move resources across the network as they are well-connected to a large number of actors (Lin, 2009). In contrast, actors with fewer or no relational ties may have limited access to the

mainstream information and may not be able to efficiently move information because the communication channels are less well-connected. However, these peripheral actors may possess greater freedom to access information that is not dominated by more “mainstream” centrally located actors (Granovetter, 1973).

A growing number of researchers in education have applied social network method to study different social phenomena in a variety of educational settings (e.g., Penuel, Sun, Frank, & Gallagher, 2012; Yoon et al., 2017). This line of research suggests that relational ties and resulting networks are consequential in supporting and constraining the exchange of instructional practice (Spillane, Kim, & Frank, 2012), student learning outcomes (Pil & Leana, 2009), teacher beliefs (Spillane, Hopkins, & Sweet, 2018), and teaching performance (Authors et al., 2014). Applying this relational approach to teacher education, research suggests that a community-based model that fosters a collaborative learning environment from which pro-social ties between/among pre-service teachers are formed may be valuable (Nobles, Dredger, & Gerheart, 2012). For instance, pre-service teachers who are socially connected to their peers, through collaborating on course projects and/or engaging in interpersonal communication with peers (e.g., social networking sites), have more opportunities to exchange and hone their instructional ideas and receive ongoing social support (Steinbrecher & Hart, 2012). Another line of research in this space underlines the importance of face-to-face interactions that allow student teachers to engage in developing and exchanging tacit and complex knowledge (Percy, 2009), provide emotional support (Richards, Levin, & Hammer, 2011), and may lead to better individual performance (Cakiroglu, 2012).

It is within this line of reasoning that we examine the social ties of pre-service teacher cohorts across different settings in response to the international call for a social, networked approach to improvement. Specifically, we intentionally focus on dyadic of pre-service teachers, namely seeking, receiving, or reciprocating behavioral patterns as they engage in instructional practice. The dyadic view enables the study to understand the formation of a relational tie. A tie

between two actors (a dyadic pair) involves how people select other actors from which they shape personal network (Centola & van de Rijt, 2015) and is critical to knowledge transfer because individuals tend to form (bridge or establish) relational ties based on various social, cognitive, and demographical factors and purposes (McPherson, Smith-Lovin, & Cook, 2001). This tie selection method to understand interpersonal relationships, as opposed to degree centrality that focuses on the amount of ties one has, provides a different but critical perspective on peer collaboration (Powell, White, Koput, & Owen-Smith, 2005) and yields more nuanced and applicable results in both research and practice (Van Duijn et al., 2004).

The Density and Reciprocity of Relational Ties

Network density and reciprocity are commonly used in most network studies in exploring the overall network structure. Network density refers to the proportion of existing to potential ties in a network. Network reciprocity refers to the proportion of reciprocal ties against all possible ties in a network. Denser network may provide greater degrees of resource flow. Reciprocity is believed to provide better opportunities for exchanges of tacit knowledge, because these mutual ties oftentimes involve certain levels of trust and support in the transmission of complex knowledge (Honig & Ikemoto, 2008). Network researchers in education report that the proportion of ties among school teachers for the discussion of education-related issues makes up about 23% to 50% of the total number of ties in a school network (Hubers et al., 2018). Research on pre-service teachers' communication pattern using social networking site indicates that pre-service teachers tend to use Facebook to collaborate with their peers and such collaboration tend to be reciprocal (Soomro, Kale, & Yousuf Zai, 2014). A recent network study on a cohort of pre-service teachers indicates a relatively less dense network structure (density of 6%) but more reciprocated tendency (24% reciprocal ties) for social support (Authors et al., 2017). Given that studies on social ties of pre-service teachers suggest a less dense network structure, we therefore hypothesize that *the network of pre-service teachers for sharing instructional materials will be made up of few ties, as such represent a sparse*

network (Hypothesis 1). In addition, as the studies suggest a reciprocal and collaborative nature of interpersonal interaction, we hypothesize that *relationships of exchanging instructional materials among pre-service teachers are likely to be reciprocated* (Hypothesis 2).

Self-Efficacy

We take social learning theory perspective (Bandura, 1977) to conceptualize self-efficacy. First, self-efficacy is associated with individuals' cognitive judgment of whether they are capable of making an effort to accomplish specific tasks within a certain period of time (Bandura, 1995); and second, self-efficacy is developed and shaped through individuals experiencing interactions with others based on their choosing (Pajares, 1996). In this view, there is a direct relationship between cognitive beliefs and reasoned behavior (Bandura, 1995), meaning that individuals' action may be dependent upon their efficacy beliefs. In addition, individuals' efficacy is shaped through the interactions with and reactions of others to the observed experience and as such, social behaviors and cognitive processes are influenced by the interplay between situated experiences and self-perception.

A number of studies in teacher education suggest that pre-service teachers with higher self-efficacy beliefs tend to be more effective teachers (Bates, Latham, & Kim, 2011; Leader-Janssen & Rankin-Erickson, 2013). For instance, research on pre-service teachers in mathematics indicates a significant and positive relationship between their self-efficacy in teaching mathematics and their mathematics teaching performance (Bates et al., 2011). In addition, pre-service teachers who report being more efficacious in terms of teaching and managing a classroom tend to feel better prepared and able to integrate new learning strategies (Anderson & Maninger, 2007), which may result in effective teaching behaviors (Putman, 2012). Furthermore, efficacious pre-service teachers are more likely to provide social support and motivate others to engage in tasks (Authors et al., 2016), suggesting the relationship between self-efficacy and the social effect (Bandura, 1977; Schunk, 1995). A more recent longitudinal study indicates an association between pre-service teachers' self-efficacy

and the size of personal support network they develop and maintain during preparations (Authors et al., 2018). Given that pre-service teachers' self-efficacy are associated with positive teaching behaviors such as engaging others, taking new approaches to teaching, we hypothesize that *pre-service teachers who report being more efficacious in their ability to teach will be more likely to be involved in (seek/ be sought for) the exchange of instructional materials* (Hypothesis 3).

Furthermore, network theorists posit that individuals that share similar personal beliefs are more likely to develop and maintain a social relationship (McPherson et al., 2001), which is a concept oft-referred to as homophily (McPherson et al., 2001). Interactions may develop trust and stronger bonds with those who possess some similar characteristics (Kramer, 1999) and such shared similarities provide a more predictable response thereby reducing the "riskiness" of exchanges (Llorens, Schaufeli, Bakker, & Salanova, 2007). We extend this idea by examining whether pre-service teachers are more likely to exchange instructional materials with peers with whom they share similar levels of efficacy beliefs. Following this literature, we hypothesize that *pre-service teachers will be more likely to be involved in (seek/ be sought for) the exchange of instructional materials with others who share a similar level of efficacy* (Hypothesis 4).

Peer Trust

Trust has received considerable attention in the literature in sociology, business, and education (e.g., Coleman, 1988; Levin, Cross, Abrams, Lesser, 2002; Tschannen-Moran, 2014) in the last few decades, and has been suggested as a critical adhesive that facilitates the connections of individuals for the exchange of resources (Bryk & Schneider, 2002; Tschannen-Moran, 2014). Trust is generally defined as individuals' willingness to take a certain level of risk to be vulnerable to another party based on the confidence that the latter party is consistently being reliable, benevolent, competent, and open (Bryk & Schneider, 2002; Tschannen-Moran, 2014). Research on teacher learning and professional development has identified ways in which trust has positively impacted individual and collective performance, for example better communication and knowledge sharing

(Curşeu, Janssen, & Raab, 2012), a reduction in anxiety during learning processes (Spector, Burkett, & Steffen, 2002), an increase in team collaboration (Forbes & Billet, 2012), and well-connected networks of teachers in facilitating their school's innovative climate (Moolenaar et al., 2014).

Given these positive impact of trust on interpersonal relationships, however, empirical studies around pre-service teacher preparation that focus on peer trust and their social connectedness are relatively scant. The majority of studies in pre-service teacher education focuses on trust in the relationships between teacher preparation institutes and universities at the organizational level (Sutherland, Scanlon, & Sperring, 2005) and/or student teachers and their mentors (Stanulis & Russell, 2000) with only few recent studies investigating trust between a cohort of pre-service teachers and its influence on teaching performance and personal network connection (Authors et al., 2016, 2018). Given that trusting relationships play a critical role in facilitating team work, social learning, and the development of a more collaborative and supportive environment (Tschannen-Moran, 2014), which in turn may yield productive outcomes, it is important to examine peer trust and its relationship with the social connectivity of pre-service teachers. Therefore, we hypothesize that *pre-service teachers who perceive greater peer trust will be more likely to be involved in (seek/be sought for) the exchange of instructional materials* (Hypothesis 5).

Following the same line of discussion on network homophily, it is reasonable to assume that pre-service teachers would more likely to establish a social tie with those peers with whom they share similar perception of peer trust, which may also facilitate mutual interaction. Therefore, we further hypothesize that *pre-service teachers will be more likely to be involved in (seek/be sought for) the exchange of instructional materials with others who share a similar level of peer trust* (Hypothesis 6).

Innovative Climate in a Form of Sharing Innovative Ideas

Aside from individual-level factors, a growing body of research literature suggests several important organizational-level factors in shaping conditions for learning and social behavior (Storey & Salaman, 2009; Moolenaar et al., 2014). Among these factors, a climate of innovation has been

identified as crucial to individual learning and organizational change and improvement (Übius, Alas, & Elenurm, 2013). The notion of innovative climate can be defined as the shared perceptions of organizational members regarding values, beliefs, practice, and behaviors that facilitate risk taking and the creation of new knowledge (Moolenaar et al., 2014). Central to this definition is “the development and transformation of new practices ... through collective social processes as a means to organizational change” (Authors et al., 2019, p. 63). Through the social processes, innovation “emerges between rather than within people” (Paavola, Lipponen, & Hakkarainen, 2004, p. 564).

Organizations with climates that are perceived to be innovative are characterized by creativity, risk taking, openness to new ideas and change, and proactivity (Dundon, 2005). Organizational members who are open to innovative ideas tend to be more motivated and willing to explore new and diverse interpersonal connections for novel exchanges (Fredrickson, 2003), and thus are likely to be well-connected (Heaphy & Dutton, 2008) and display positive emotions such as enthusiasm, elation, and excitement and high work engagement (Spreitzer, Sutcliffe, Dutton, Sonenshein, & Grant, 2005). In contrast, members that are less risk-tolerant may less likely to establish new interpersonal relations (Fredrickson, 2003) and thus have fewer opportunities for affirmative and constructive exchanges (Collins, 1993), and may not display positive emotional excitement that can arise from new experiences (Spreitzer et al., 2005). In teacher education, being open and willing to explore new ideas may be crucial for pre-service teachers during preparations as this propensity toward innovativeness is key to facilitate individual learning and better instructional practice. Given the link in the literature between innovative climate and the generation of new ties, we therefore hypothesize that *pre-service teachers who share innovative ideas with peers will be more likely to be involved in (seek/be sought for) the exchange of instructional materials* (Hypothesis 7).

Individual Characteristics Associated with the Formation of Relational Ties

Social network research both inside and outside education has indicated that demographic characteristics of individuals may influence how individuals establish their social network ties (e.g.,

Spillane et al., 2012; Stoloff, Glanville, & Bienenstock, 1999). Particularly, gender appears to be one important factor in explaining the tie formation. For instance, women tend to engage in more social relationships than men in business organizations (e.g., Stoloff et al., 1999). Female teachers are more likely to seek out for advice around instructional practices than their male counterpart (Authors et al., 2016). As educators around the world is often “gender-skewed” with a predominantly female educators, the pattern of social relationships in cohorts of pre-service teachers may be segregated across gender lines. Given that our sample is predominantly female and that women tend to have a higher likelihood to be involved in social relationships, we hypothesize that *female pre-service teachers are more likely to be involved in (seek/ be sought for) the exchange of instructional materials* (Hypothesis 8).

In addition, previous research further suggested that same-gender work relationships are more frequent than opposite-gender work relationships (Faris & Felmlee, 2011); and that school teachers tend to provide and receive advice from a colleague of the same gender (Authors et al., 2016; Spillane et al., 2012). Based on gender similarity in social connectivity and the limited work available in education, we hypothesize that *pre-service teachers are more likely to exchange instructional materials with same-gender peers than with different-gender peers* (Hypothesis 9).

Methods

Sample

This cross-country exploratory study was conducted in three purposively selected university-based teacher preparation programs in England, Spain, and US that employ a cohort model of training. A cohort model adopted in this and many other programs internationally can be generally defined as a group of people who stay and learn together from the beginning to the end of a program (Goodlad, 1990). The programs in these countries serve as potentially instructive cases given each with its unique preparation system and their long established reputation from the teaching profession and community for producing high quality teachers. During the coursework,

pre-service teachers were exposed to opportunities to engage in multiple team-based, hands-on teaching experiences in laboratory situations.

The English cohort includes 37 pre-service teachers training to teach mathematics to students in secondary schools on a mix of one-year graduate level university-led and school-centred (School Direct) programmes. Of the 37 pre-service teachers in this cohort, 49% were females. During the 2014-15 academic year network data were collected on four different occasions during the year-long programme (October 2014, December 2014, March 2015 and May 2015). The data analyzed here represent the peer group networks collected at the final, May timepoint. By this stage of the programme the pre-service teachers were all well into their second of two teaching placements. The trainee teachers all had achieved a final review grade for their teaching of at least “good” (second highest level on a four-point ordinal scale) including seven trainees who achieved an “outstanding” grade for the quality of their teaching.

The Spanish cohort includes 45 pre-service teachers in a well-regarded university-based Teacher Training Primary Education Programme in Catalonia (Barcelona), Spain. Individual participants received an online voluntary survey at the end of the one-year training programme during their internships in fall 2014. Of the 45 pre-service teachers, 69% were females; the averaged academic performance as measured by four-point GPA is 1.77 (SD=0.39); and the averaged final training performance on a 10-point scale is 7.65 (SD=0.98).

The US cohort includes 48 pre-service teachers enrolled in four credential programs that offer an M.Ed. degree and teaching credential for multiple subjects as well as bi/multi-lingual and special education credentials for elementary and secondary school teachers. All 48 participants completed an online survey at three points in time over the course of a 10-month program during 2012. The US data presented in this study is from the final timepoint to ensure comparability across settings. Of all the participants, 83% were females. The sample consisted of 42% Asian American,

27% Caucasian or White, 15% Latino, and 17% Other. About 44% of the pre-service teachers had a GPA above 3.5 and the average level of state level credential examination is above proficient.

Instruments

Social networks: Instructional materials (IMs) and new ideas about teaching (NIs).

We asked pre-service teachers to assess the frequency of interactions with their peers from whom they seek instructional materials they used in teaching practices (Instructional Materials, IMs) and from whom they seek new ideas about teaching (New Ideas, NIs) on a 4-point frequency scale (from 1 = 'once in the past two months' to 4 = '1-2 times a week'). We used UCINET social network software (Borgatti, Everett, & Freeman, 2005) to generate measures for network properties. As seeking and exchanging instructional materials and new ideas is desired in most collaborative learning environments, it is important to examine the degree of mutual interaction and the degree of seeking or providing that kind of materials and ideas. We therefore focus on individual-level measures, i.e., ego-reciprocity, outdegree and indegree. The ego-reciprocity is calculated as the ratio of reciprocated relationships to the total number of relationships for an actor. The outdegree of a pre-service teacher corresponds to the number of peers nominated by the pre-service teacher to whom they reached out and can be interpreted as the pre-service teacher's "activity." The indegree of a pre-service teacher reflects the number of peers from whom the pre-service teacher received a nomination, and can thus be regarded as an indication of a pre-service teacher's "popularity" in providing instructional materials or new ideas for their peers.

As this study examines two types of network relationships, it is important to check for collinearity between the two network matrices. Prior to hypothesis testing, we employed the Quadratic Assignment Procedure (QAP) to identify the strength of correlation between the two network structures. The QAP result indicates a weak to medium correlation between IMs and NIs network matrices ($r < .40$) across study sites, suggesting the two relations representing distinct concepts and thus allowing for further analysis.

Self-efficacy. We drew upon the Teacher Efficacy Scale used in previous work (Tschannen-Moran & Hoy, 2001) that examined the perceptions of self-efficacy for instructional improvement, which allows us to capture perceptions of individual efficacy about instructional practice. The self-efficacy scale comprised of five items based on a 9-point Likert scale ranging from 1 (Not at all) to 9 (Always). Across all sites, principal component analysis (PCA) with varimax rotation yielded a single-factor solution with internal reliability α ranging from .80 to .92.

Peer trust. We assessed peer trust through a previously validated trust scale (Authors et al., 2017). Participants were asked to respond to each of the six trust items on a 9-point Likert scale, ranging from 1 “very strongly disagree” to 9 “very strongly agree.” PCA on the six trust survey items using varimax rotation yielded a single-factor solution. Items that had a communality of less than .50 were removed. The internal reliability α of the scale ranges from .89 to .97.

Table 1 provides factor loadings and reliability of self-efficacy and peer trust scales for each study site.

Insert Table 1 about Here

Data Analysis

We first present descriptive statistics for the scales assessing self-efficacy and peer trust as well as network properties of both IMs and NIs relations. We then test our hypotheses by conducting a series of selection models (Dujin, 1998) to investigate the extent to which pre-service teachers’ perceived self-efficacy and peer trust and demographic characteristics affect the formation of IMs ties, controlling for NIs relation and gender. P2 modeling addresses the interdependency of the network data of the dependent variable (relationships among individuals). The following models are proposed:

Pair Level (Relationship in between i and i')

$$\log \log \left[\frac{p(\text{seeking or receiving instructional materials}_{ii'})}{1-p(\text{Y1:seeking or receiving instructional materials}_{ii'})} \right] = \theta_{0i} + \theta_{0i'} + \theta_{1} \text{same gender}_{ii'}$$

Nominator Level (i)

$$\theta_{0i} = \gamma_{00i} + \gamma_{01i} \text{Perceived self efficacy}_i + \gamma_{02i} \text{Peer trust}_i + u_i$$

Nominatee Level (i')

$$\theta_{0i'} = \gamma_{00i'} + \gamma_{01i'} \text{Perceived self efficacy}_{i'} + \gamma_{02i'} \text{Peer trust}_{i'} + u_{i'}$$

The models were analyzed with the p2 program in the StOCNET software (Van Duijn, Snijders, & Zijlstra, 2004). The p2 model is developed to handle dichotomous dyadic outcomes. In contrast to a univariate logistic regression model, the p2 model controls for the interdependency that resides in social network data. It regards sender and receiver effects as latent random variables that can be explained by sender and receiver characteristics (Van Duijn et al., 2004). It also produces reciprocity covariate that measures similarity of two individuals on a given characteristic, e.g., similarity of gender. In p2 analyses, the dependent variable is the aggregate of all the nominations a network member sent to or received from others. A positive effect thus indicates that the independent variable (e.g., a pre-service teacher's perceived level of efficacy) has a positive effect on the likelihood of having a relationship. The regression coefficients (reported as log odds ratios) reflect the expected change in the log of the odds associated with a one-unit change in the independent variable

(Pedhazur, 1997). For more information regarding the algorithm and interpretation² of p2 models, please see Van Duijn et al's (2004) work.

Results

Descriptive Statistics of Study Variables in England, Spain, and US

Table 2 presents the descriptive statistics of the study variables in England, Spain, and US. The results indicate that across sites there are higher levels of perceived self-efficacy and peer trust reported by pre-service teachers (mean ranging between 6.5 and 7.1). The English cohort has the highest level of perceived self-efficacy and peer trust (mean = 7.05 and 7.13, respectively), followed by the Spanish cohort (mean = 6.84 and 6.87, respectively) and the US cohort (mean = 6.45 and 6.77, respectively).

² The parameter estimates in p2 models can be interpreted in the following way. The main parameters of interest concern the sender effects and receiver effects, meaning effects that signify the probability of sending or receiving IMs nomination(s). A positive parameter estimate thus signifies a positive effect on the probability of an IMs relationship (Veenstra et al., 2007). For example, a positive sender effect of gender (dummy coding; ref/male) would indicate that male pre-service teachers would have a higher probability of seeking IMs ties than female pre-service teachers. Another main parameter of interest is the homophily effects of the relational covariates such as gender, perceived level of efficacy and peer trust. For these relationship covariates, the p2 software constructs dyadic matrices based on the (absolute) difference between two respondents. For example, the relationship between two female pre-service teachers would be coded as a relationship between pre-service teachers who are the same gender. To facilitate the interpretation of the model, we labeled the dyadic parameters "different gender," "different self-efficacy," "different peer trust." A negative parameter estimate for "different gender," for instance, would thus indicate that a difference in gender is negatively associated with the probability of having an IMs relationship. Meaning, pre-service teachers would be less likely to report having an IMs relationship with peers who are different gender, and conversely, the IMs ties would be more likely present among same-gender pre-service teachers. As such, negative parameters would provide evidence of the hypothesized homophily effects.

In p2 models, two parameters are by default included as they "control" for network effects. The first default parameter is the overall mean density effect. A positive estimate for the density effect indicates that in general, the sample networks are rather dense, while a negative density effect reflects that the networks are rather sparse. The second default parameter is the overall mean reciprocity effect. A positive estimate for the reciprocity effect suggests that symmetric relationships are more likely to occur than asymmetric relationships, and vice versa.

As suggested (Long, 1997), we used the Wald statistic that is then compared to the χ^2 distribution with one degree of freedom to calculate the significance of the effects. In addition, to aid interpretation of statistical significance we report quantiles from the distributions of estimation samples, which provide the Bayesian analogue to a confidence interval. The estimate will be statistically significant ($p < .05$) if the quantiles between 2.5 and 97.5 do not include "zero."

Insert Table 2 about Here

In terms of social network properties for the IMs relationship, the results indicate that of all possible ties that can exist among the pre-service teachers only 2-5% of the ties that exchange instructional materials are present from across the study sites (density ranging between 0.02 and 0.05). Of those ties that are present, the English cohort has the highest percentage of reciprocated ties between dyads of peers (network reciprocity = 0.19), compared to 14% of reciprocated ties for the Spanish cohort and 6% for the US cohort. As for seeking others for instructional materials (outdegree), the Spanish cohort is on average connected with 5% of their peers to exchange instructional materials, whereas the English and US cohorts are connected with approximately 2% of their peers for this matter. Of these outgoing ties for exchange of instructional materials, the English cohort has the highest ego-reciprocity (0.32), meaning that approximately one third of the outgoing ties from the English cohort is reciprocated (i.e., mutually exchanging instructional materials), compared to 25% for the Spanish cohort and 12% for the US cohort.

The network properties of sharing new ideas about teaching (NIs) yields a somewhat different pattern from the IMs network. For network density, NIs networks appear to be slightly more dense than the IMs network structure for both Spanish and US cohorts, although non-significant. The proportion of reciprocated ties across network for NIs relationship is greater than IMs relationship for both Spanish and US cohorts but smaller for English cohort. In terms of reaching out for new ideas, on average, the Spanish cohort seeks approximately 9% of their peers for new teaching ideas, whereas the English cohort is connected to 2% of their peers and 7% for the US cohort for this matter. Of all these outgoing ties, 42% of the ties from the US cohort are reciprocated, compared to 38% for the Spanish cohort and 22% for the English cohort.

In sum, there is variation in network properties among the study cohorts of pre-service teachers across the three sites. To explore the similarities and differences across sites and test our hypotheses, we present findings from our p2 models (Table 3). We examine the extent to which

pre-service teachers' perceptions of self-efficacy and peer trust are associated with the likelihood of sending, receiving, and reciprocating IMs ties with their peers.

Insert Table 3 about Here

Density (H1) and Reciprocity (H2) of IMs Ties

The p2 models provide general parameters of the overall network structure in order to get a sense of the overall network structure of the relationship under study. Supporting H1, the findings indicate that the IMs network structure tends to be sparse among the English, Spanish and US cohorts, as indicated by a negative density effect, which also corresponds to the network descriptive statistics. By the end of the year-long programme the peer groups had only very limited opportunities to meet face-to-face as they were in field teaching placement. This may explain in part why their peer network is sparse. The IMs relationship also tends to be reciprocated (mutual) as opposed to unidirectional, as evidenced by the positive overall reciprocity effect, supporting H2.

Characterizing Pre-service Teachers Who Seek Instructional Materials

Self-efficacy (H3), peer trust (H5), and gender (H8). The findings indicate a statistically significant and positive sender effect for self-efficacy across the English, Spanish, and US cohorts, supporting H3. That is, the pre-service teachers who are more efficacious in their ability to manage classroom and address students' behavioral issues are more likely to identify source of information by seeking instructional materials that they would use in their teaching activities. The findings also indicate a statistically significant and positive effect for peer trust for the English cohort on the likelihood of seeking instructional materials, supporting H5. In other words, the English pre-service teachers who reported higher trust among their peers were more likely to reach out to their peers for instructional materials. Finally, there is a statistically significant and positive sender effect for gender for the Spanish cohort, meaning that male pre-service teachers are more likely to reach out to their peers for instructional materials than their female counterparts.

Characterizing Pre-service Teachers Who Are Sought for Instructional Materials

The p2 model did not yield any statistically significant covariates in characterizing the pre-service teachers who are sought for instructional materials across cohorts. This suggests that there is no significant difference in the variables in explaining ties around the provision of instructional materials.

Similarity in Characteristics in Forming a Tie for Instructional Materials

Results of the relationship covariates indicate a statistically significant and positive association with NIs relationship on the likelihood of establishing a tie for instructional materials across the English, Spanish and US cohorts. This means that the pre-service teachers who exchanged new ideas about teaching were more likely to also exchange instructional materials. There is no significant relational effect for gender, self-efficacy, and peer trust on the likelihood of forming a tie for sharing instructional materials. In terms of reciprocity effect, the findings indicate a significant and positive effect for peer trust among the English cohort, meaning that the English pre-service teachers who perceived different levels of peer trust were more likely to establish mutual relationships in exchanging instructional materials, contrary to H6. Similarly, a significant and positive reciprocity effect is found for self-efficacy for the US cohort on the likelihood of establishing a reciprocated tie. This suggests the US pre-service teachers who perceived different levels of self-efficacy were more likely to mutually exchange instructional materials with each other, not supporting H4. Finally, there is a significant and negative reciprocity effect for gender among the US pre-service teachers, which indicates that the US cohort tend to mutually exchange instructional materials with same gender peers, supporting H9.

In sum, our findings fully supported six hypotheses in the overall network structure, individual effect for self-efficacy and peer trust, as well as dyadic effects for gender and NIs exchange. Three of the study hypotheses were not supported including the homophily effects for self-efficacy and peer trust and the individual effect for gender. Table 4 provides a summary of the study hypotheses and findings.

Insert Table 4 about Here

Discussion and Conclusion

Responding to the recent call for a more social and collaborative approach to improvement, this exploratory cross-country study builds on rapidly growing scholarship using social network analysis to examine the social side in education and further sheds new light on conventional understanding of pre-service teacher development across settings. This work adds to an emerging set of social network data about peer relationships during teacher education programs. Understanding the mechanisms through which pre-service teachers' relational ties can be developed within and across each of the settings may further assist in rethinking the design of teacher preparation programs including curriculum, training activities, and social settings that better serve the learning needs of pre-service teachers both socially and professionally.

The Role of Self-Efficacy and Peer Trust in IMs Ties

This study fully supported our hypotheses around self-efficacy and peer trust in terms of individual sender effect. Our read of the literature led us to hypothesize that self-efficacy would be an important intrinsic factor and so the findings around self-efficacy were validating, but not surprising. It seems that at the end of preparation, the pre-service teachers had a growing competence in their skill sets and as such those with greater self-efficacy were able to identify source of information to which they reach out for instructional materials. Research on organizational learning indicates the important role of "seeking" behavior particularly in the area of sharing and development of knowledge (Finnigan, Daly, & Stewart, 2012). This suggests that self-efficacy not only helps individuals' ability to identify sources of expertise they need in teaching practices but also shapes their behaviors in terms of the important activity of reaching out to others as previous work suggests (Authors et al., 2017). Obtaining useful information may also positively influence individuals' confidence level (Loera, Nakamoto, Rueda, Oh, Beck, & Cherry, 2013) in that having an accurate assessment of their own abilities and skills may help individuals identify areas that are in

need of improvement and in turn build a sense of competence (Holmes, Preston, Shaw, & Buchanan, 2013). This finding also confirms previous research around the interplay between teacher self-efficacy and their collaborative behaviors (Bates & Khasawneh, 2007).

Contrary to the seeking behavior, however, none of the receiver effects examined in this study are significant across settings, meaning that the extent to which pre-service teachers' being nominated as someone from whom others would seek instructional materials is not necessarily related to gender, perceived self-efficacy or peer trust. It could be the case that in our sample the pre-service teachers were encouraged to engage in discussion and collaboration with their peers, and as such reaching out to others have become the norm of learning during preparations. Providing the opportunities for peer interaction can be consequential to the development of self-efficacy (Spillane et al., 2018).

Finally, we are somewhat surprised about the finding on homophily effect for self-efficacy, particularly in the US cohort, that the pre-service teachers with different perceived levels of self-efficacy are more likely to mutually exchange instructional materials. The finding did not support previous network research that suggests homophilious interaction based on similar personal beliefs (Coburn et al., 2013; Spillane et al., 2018). This may be in part due to the fact that the US cohort are exposed to a variety of opportunities to engage in inter-personal, inter-group, team-based, hands-on learning experiences. For instance, in many of the mandatory methods courses, the pre-service teachers were required to engage in online discussion with and review works of peers from within and other teams for weekly reflections, small class assignments, and final team projects. By reviewing the work of, and providing feedback to, other cohorts, the pre-service teachers are able to learn to teach others how to teach, design class lessons, and manage a classroom. Those with lower confidence in managing classroom and student behaviors are thus likely to be working with those with greater confidence, and vice versa; hence increasing the likelihood of mutual connectivity at the end of preparation. A recent study by Spillane and colleagues (2018) suggests that teachers'

beliefs are mutable under certain conditions such as reform-related interventions (Gill, Ashton, & Algina, 2004). It is reasonable to speculate that the reciprocated ties between pre-service teachers with dissimilar efficacy beliefs are also the results of this intentional cohort approach to individual learning and development.

The Role of New Ideas Exchange in IMs Ties

The finding around exchange of new ideas is consistent across study settings and suggests that pre-service teachers who exchange new ideas about teaching are more likely to establish a relationship for exchanging instructional materials. The finding is very much intuitive and corresponds to previous studies on organizational learning and innovation in relation to social ties (e.g., Battilana & Casciaro, 2013; Dahlander & McFarland, 2013). The literature suggests that organizational members who are open to new ideas are more willing to explore diverse interpersonal connections for novel exchange (Fredrickson, 2003) and thus tend to be well-connected (Heaphy & Dutton, 2008). It might well be the case that during preparations pre-service teachers have been exposed to a variety of collaborative opportunities encouraging them to interact within and between cohorts and access new information to come up with project ideas and solve problems that are too challenging for single individual to accomplish. These norms are identified particularly common for collaboration to occur in natural and organizational sciences (Dahlander & McFarland, 2013). As such, it is not surprising to correlate the NIs network relation with the tie that bridges the sharing of useful instructional materials. Research on organizational network and innovation suggests the merit of exploring new and diverse knowledge and resources for better development of individual human and social capital (Finnigan et al., 2012). Having the opportunities and channels for exchanging ideas may better stimulate the use and refine of individual knowledge and in the long terms improve individual and collective actions toward innovation.

The Role of Peer Trust in IMs Ties

The findings on peer trust are salient in the English cohort as both sender and reciprocity effects. The finding around positive sender effect for peer trust on the likelihood of reaching out to others for instructional materials corresponds to a number of previous studies on relational trust and social ties (e.g., Moolenaar et al., 2014; Van Maele, Forsyth, & Van Houtte, 2014). The English pre-service teachers who perceived greater peer trust might be more willing to provide and exchange social and emotional support with their peers, as has been shown in earlier studies suggesting trust as a key resource for establishing ties for social support (Authors et al., 2017), individual and organizational improvement (Bryk & Schneider, 2002), and promoting innovation (Moolenaar et al., 2014). In addition, trust offers ways for teachers to build a sense of security and certainty through a general expectation that the action of others can be relied on (Bryk & Schneider, 2002), particularly when they are encouraged to work with peers from other cohorts they are less familiar. Having a sense of relational certainty may assist pre-service teachers in engaging in more timely and accurate communications and knowledge sharing (Bulu & Yildirim, 2008), reducing a sense of professional isolation (Durksen & Klassen, 2012), and increasing team collaboration (Forbes & Billet, 2012) and teacher professionalism (Tschannen-Moran, 2009). In this regard, it is reasonable to infer a similar and positive effect for trust on collaboration among pre-service teachers as they experience in clinical settings (e.g., field placement, practicum). Furthermore, seeking out for resources may look like a sign of weakness (Bohns & Flynn, 2010). This concern is particularly relevant to advice-seeking contexts in which the seekers risk exposing their vulnerability and may resist imposing on others for assistance (Collins & Feeney, 2000). However, with a certain level of trust, people may be more willing to take the risks of being vulnerable to others. We may speculate that the English pre-service teachers who perceive high trust are willing to be open to others and risk-tolerant based on the perceptions that their peers will act in manner that can be reliable and in the best interest of them (Tschannen-Moran, 2004), and as such they are more likely to reach out to others for materials that they would use in practice.

Creating trusting environment for learning that supports sharing and collaboration is important for teachers, as demonstrated in many school reform cases in which teachers are more effective when they feel respected (Tschannen-Moran, 2014) and trust the people within the school have their best interest at heart (Bryk & Schneider, 2002). We believe this is also the case for pre-service teacher during preparation. Such supportive condition for collaboration has implications for successful educational reform in the long term as pre-service teachers enter the field. Recent research call for teachers' social and emotional competence and well-being in promoting student-teacher relationships and learning outcomes (e.g., Kendziora & Yoder, 2016) and starting this work early on in preparation phase may pay dividends. Attention to not only the pattern of relationships (i.e., seeking resources), but the quality of exchanges (peer trust) and social norms that are set in a cohort is likely to be critical.

Conclusion: Efficacy, Explore, and Exchange

Understanding the pattern of professional relationships (the exchange of instructional materials and new ideas) of pre-service teachers and associated factors such as self-efficacy and peer trust has the potential to assist teacher educators to reflect upon and shape the development of pre-service teachers in ways that leverage social capital. To sustain individual and collaborative learning over the course of preparation, teacher educators may consider providing additional mastery opportunities directly related to nationwide policy context in which teachers go about their work and creating conditions that support the development of these positive factors. This will likely strengthen pre-service teachers' confidence to teach and learn, be reflective, and enhance their willingness to take risks on exploring new approaches to teaching and learning, which in turn may lead to innovation (Moolenaar et al., 2014) and overall occupational commitment (Klassen & Chiu, 2011). Our work is unique in the field of teacher education in that it investigates the characteristics of ties between dyads of pre-service teachers across different contexts and perceptions that have a potential impact on their instructional practices. The use of social networks can further assist

teacher educators in identifying the needs for building and sustaining a community of learning as well as a climate of innovation.

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Tables

Table 1: Factor Loadings and Reliability for Self-Efficacy and Peer Trust Scales

Item	α and factor loading		
	England	Spain	US
Self-efficacy	(.88)	(.80)	(.92)
1. How much can you control disruptive behavior in the classroom?	.85	.84	.92
2. How much can you calm a student who is disruptive or noisy?	.87	.76	.89
3. How much can you do to get children to follow classroom rules?	.81	.74	.88
4. How well can you establish a classroom management system with each group of students?	.92	.72	.88
5. To what extent can you use a variety of assessment strategies?	.71	.51	.81
Peer trust	(.97)	(.89)	(.92)
1. Even in difficult situations, I can depend on my classmates.	.95	.91	.92
2. I can always count on my classmates.	.95	.87	.90
3. I trust my classmates.	.94	.87	.88
4. I find that my classmates are open to me.	.89	.84	.84
5. I really care about my classmates.	.91	.79	.81
6. I also share personal information with my classmates.	.94	.49	.78

Note: Value in parenthesis represents reliability Cronbach's alpha (α).

Table 2: Descriptive Statistics of Study Variables

	England	Spain	US
Individual perceptions			
Self-efficacy	7.05(0.62)	6.84(0.77)	6.45(1.00)
Peer trust	7.13(1.45)	6.87(0.74)	6.77(0.91)
Social networks			
Instructional materials (IMs)			
Network density	0.02	0.05	0.02
Network reciprocity	0.19	0.14	0.06
Out/indegree	2.33(3.33)	5.20(8.40)	2.31(3.78)
Ego-reciprocity	0.32	0.25	0.12
New ideas about teaching (NIs)			
Network density	0.02	0.09	0.07
Network reciprocity	0.13	0.24	0.27
Out/indegree	2.03(3.58)	8.49(10.45)	7.18(8.04)
Ego-reciprocity	0.22	0.38	0.42

Note: Values of individual perceptions indicate mean and standard deviation in parenthesis. Values of out/indegree indicates the standardized form of mean and standard deviation. Values of ego-reciprocity can be interpreted in percentage.

Table 3: Parameter Estimates of the Multilevel $p2$ Model: Displaying the Effect of Individual, Demographic, and Dyadic Characteristics on the Probability of Having “Instructional Materials” Relationship at the End of the Preparation Program in England, Spain, and US

	England ¹		Spain ²		US ³	
	Parameter estimate	SE	Parameter estimate	SE	Parameter estimate	SE
ll mean						
Density	-8.964*	3.147	-6.659*	1.554	-0.931	3.566
Reciprocity	2.602*	1.228	3.478*	0.836	-1.874	2.520
Individual covariates						
(Instructional materials)						
Gender	-0.201	0.478	1.333*	0.577	-1.137	1.268
Self-efficacy	0.570*	0.248	0.370*	0.169	1.119*	0.556
Peer trust	0.383*	0.197	-0.038	0.191	-0.769	0.460
Demographic covariates						
(Instructional materials)						
Gender	-0.525	0.525	-0.539	0.344	-1.701	1.240
Self-efficacy	0.009	0.253	-0.101	0.128	-0.428	0.260
Peer trust	-0.145	0.234	0.010	0.116	-0.260	0.261
Relationship covariates						
Different gender	-0.780	0.458	-0.250	0.345	1.338	1.065
Different self-efficacy	-0.380	0.294	0.086	0.147	-0.324	0.257
Different peer trust	-0.410	0.249	-0.032	0.158	-0.513	0.348
Exchange new ideas	5.614*	0.824	4.230*	0.519	5.395*	0.519
Locality covariates						
Different gender	0.814	1.058	0.123	0.799	-6.164*	2.818
Different self-efficacy	0.098	0.737	-0.371	0.321	2.221*	0.942
Different peer trust	0.843*	0.421	-0.023	0.334	0.861	1.114
Exchange new ideas	-2.041	1.971	-0.116	0.844	-1.962	1.833
Random effects						
Sender variance	0.603	0.430	2.063*	0.711	3.204*	1.625
Receiver variance	0.489	0.396	0.205^	0.100	0.390	0.282
Sender-receiver covariance	0.109	0.297	-0.310	0.228	-0.543	0.610

Notes: ¹Examination of 812 potential dyadic relations from 37 pre-service teachers. ² Examination of 1,980 potential dyadic relations from 45 pre-service teachers. ³Examination of 2,256 potential dyadic relations from 48 pre-service teachers *p < .05.

Table 4: Summary of Study Hypotheses and Findings

Hypothesis	Result	Finding
H1: The network of pre-service teachers for sharing instructional materials will be made up of few ties, as such represent a sparse network .	Supported	The IMs network structures across three cohorts tend to be sparsely connected.
H2: Relationships of exchanging instructional materials among pre-service teachers are likely to be reciprocated .	Supported	The IMs network structures across three cohorts tend to be reciprocated.
H3: Pre-service teachers who report being more efficacious in their ability to teach will be more likely to be involved in (seek/be sought for) the exchange of instructional materials.	Supported	Across three cohorts, self-efficacy is positively associated with the likelihood of seeking instructional materials.
H4: Pre-service teachers will be more likely to be involved in (seek/be sought for) the exchange of instructional materials with others who share a similar level of efficacy .	Not supported	Dyadic effect is only significant in the US cohort, indicating that different levels of perceived self-efficacy are associated with forming mutual connections.
H5: Pre-service teachers who perceive greater peer trust will be more likely to be involved in (seek/be sought for) the exchange of instructional materials.	Supported	Peer trust is only significant as a sender effect for the English cohort, indicating that peer trust is positively related to the likelihood of seeking instructional materials.
H6: Pre-service teachers will be more likely to be involved in (seek/be sought for) the exchange of instructional materials with others who share a similar level of peer trust .	Not supported	Dyadic effect is only significant in the English cohort, indicating that pre-service teachers with different perceived levels of peer trust are more likely to establish mutual ties.
H7: Pre-service teachers who share innovative ideas with peers will be more likely to be involved in (seek/be sought for) the exchange of instructional materials.	Supported	Across three cohorts, exchanging new ideas about teaching is positively associated with having a tie for exchanging instructional materials.
H8: Female pre-service teachers are more likely to be involved in (seek/be sought for) the exchange of instructional materials.	Not supported	Gender is significant as a sender effect only for the Spanish cohort, indicating that male pre-service teachers are more likely to seek instructional materials.
H9: Pre-service teachers are more likely to exchange instructional materials with same-gender peers than with different-gender peers.	Supported	Gender homophily is significant as a dyadic effect only for the US cohort, indicating that pre-service teachers are more likely to share instructional materials with same gender peers.