

IMPROVING TRUST, IMPROVING SCHOOLS: FINDINGS FROM A SOCIAL NETWORK ANALYSIS OF 43 PRIMARY SCHOOLS IN ENGLAND

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1: OBJECTIVES

The use of research evidence by teachers is currently experiencing global policy and practice interest, with many governmental agencies touting the importance of research-informed efforts at improvement. As school systems world-wide embark and expand on serious structural and instructional changes, the result is that school leaders, teachers, and educators in general, must now demonstrate the ‘proof’ behind their teaching and learning strategies as well as provide evidence prior to undertaking interventions. As a consequence, the use of research and evidence is being positioned as vital to providing validity to practice [*reference removed for peer review*]. However, despite this growing press for the use of research evidence there has been a failure of research to make sustained impact on the practices of teachers or even enter the school building (Bryk *et al.*, 2011; Taylor, 2013). Likewise, despite considerable activity, the development of processes for the effective connection and application of research evidence to practice remains underdeveloped (Slavin, 2008; Gough *et al.*, 2011). Given the importance of the issue, the lack of progress in the area, and the resurgence of interest in research evidence, this paper seeks to add insight to the fields of research/evidence-use and school improvement, by examining what drives teachers’ perceptions that their school: 1) encourages the use of research evidence to support the improvement of teaching practice; and 2) whether teachers perceive that the school improvement strategies of their school are grounded in research and evidence on effective practice.

In meeting our goals, the paper pursues three objectives. First, we examine the impetus on schools in England’s self-improving, school led, education system that encourages the seeking and sharing of effective practices, including those grounded in research and evidence. As part of this first objective, we also explore the pivotal role of school leaders in achieving evidence informed self-improvement (including ensuring teaching staff are able to identify and engage with high quality research). In addition to the usual requirements for school leaders to build capacity and establish the cultures and structures required for organizational learning, we also look at a less well reported requirement: the role of leaders in facilitating effective relationships to ensure that social capital is available and can flow throughout schools. Correspondingly we also outline the vital importance of high levels of intra-school trust to school improvement, and in particular, school improvement steeped in research evidence use.

Second, we outline the Education Endowment Foundation funded Research Learning Communities (RLC) project. Designed to facilitate research led self-improvement, the RLC project is unique in that it uses Social Network Analysis to identify teachers with high levels of research/evidence-use related social capital, in order that they might develop and lead research-informed effective practice within schools. Importantly, however, our predictive model, developed as part of the project and based on 828 teachers in 43 schools, also provides new perspectives on the vital role of trust, a culture of organizational learning and the frequency and quality of interactions between teachers in achieving research/evidence informed self-improvement. Our third objective is to examine the implications of our analysis not only for school leaders but also at the system level.

2: PERSPECTIVES

2.1: THE 'SELF-IMPROVING SCHOOL-LED SYSTEM' IN ENGLAND

The seeking, use and sharing of effective pedagogic practice is viewed as vital to school improvement and as a necessary response to the structural changes facing many school systems worldwide [*reference removed for peer review*]. This is especially apparent in England, where the current direction of education policy is providing impetus for teachers and schools to generate their own improvements in teaching and learning.

The current UK government focus for education in England has been to develop a 'self-improving school-led school system'. Greany (2014), suggests that there are four core criteria for self-improvement including: 1) teachers and schools being responsible for their own improvement; 2) teachers and schools learning from each other and from research so that effective practice spreads; 3) the best schools and leaders extending their reach across other schools so that all schools improve; and that 4) government support and intervention is continuously minimized.

2.2: EVIDENCE-INFORMED PRACTICE

Simultaneous to the idea of self-improvement, the use of research and evidence is now positioned as providing validity to teachers and learning ([*references removed for peer review*]; Stoll, 2015a), leading to the coining of the term, 'evidence informed practice' (Saunders, 2015) (EIP). England's Department for Education suggests such practice may be thought of as: "a combination of practitioner expertise and knowledge of the best external research, and evaluation based evidence" (www.education.gov.uk, 2014). In relation to this definition, we consider external research to be

that which has been peer reviewed and published by academic researchers. Evaluation-based evidence, meanwhile, is considered to comprise meta-analyses or syntheses such as those produced by Hattie (e.g. 2011) or the Sutton Trust-EEF's *Teaching and Learning toolkit* (Sutton Trust-EEF, 2013). In other words, this latter category represents broader overarching assessments of specific approaches to teaching and learning, which include summary assessments of how typically effective such approaches are in improving student outcomes.

There are numerous reported benefits to practitioners of engaging in EIP. For example, Supovitz (2015) observes that a common characteristic of high performing school systems is that they facilitate the collaborative examination of research and data evidence in order to identify both likely problem areas (in relation to teaching and learning) and potential solutions to these problems. Likewise Mincu (2013) reports correlational evidence suggesting that where research and data are used as part of high quality initial teacher education and ongoing professional development, they make a positive difference in terms of teacher, school and system performance (also see Sebba *et al.*, 2012). Furthermore, 'research-engaged' schools can shift from an instrumental 'top tips' model of improvement to a learning culture in which staff work together to understand what appears to work, when, why, and under what conditions (Handscomb and MacBeath, 2003; *[reference removed for peer review]*).

Given the current emphasis on self-improvement, it is not surprising that evidence and research use has become an intentional feature of recent English education policy. Greany (2014), for example, notes that Teaching Schools, outstanding schools with a designated role to (amongst other things) co-ordinate Research and Development (R&D) across an alliance of partner schools, are required to demonstrate "clear evidence of strong engagement in school-based practitioner-led research, as well as support for teachers gaining academic and professional awards"¹. Those successful in achieving designation are expected to build on existing research as they contribute to alliance and wider priorities, base new initiatives on existing evidence and measure the impact of these initiatives, ensure that staff use existing evidence, and provide necessary time and support for staff to participate in R&D activities (Stoll, 2015b: 7).

2.3: BECOMING EVIDENCE INFORMED

At the same time, little has been written in terms of how teachers might actually become evidence

¹ The Teaching Schools Prospectus, <http://www.nationalcollege.org.uk/docinfo?id=146256&filename=teaching-schools-prospectus.pdf>

informed (Godfrey 2014; Saunders, 2014). An innovative approach to achieving EIP is provided by *[reference removed for peer review]*, however; who, drawing on the definition of EIP set out above, argue that any joining of research and evidence with practitioner best practice must have at its centre the notion of the 'expert' practitioner. That is, taking Flybjerg's (2001: 14) notion of an expert as someone who "[exhibits] thinking and behavior that is rapid, intuitive, holistic [and] interpretive...". *[reference removed for peer review]* argue that expertise of this type can only be achieved via a process of knowledge 'creation' in which the producers and users of formal knowledge are able to come together to create 'new' knowledge. Such knowledge should then be internalized through practice, as teachers continually draw upon and appraise its applicability to different situations/cases (Nonaka and Takeuchi, 1995). Adopting *[reference removed for peer review]*'s approach, our notion of how EIP operates, and how the benefits of EIP for teachers accrue, is thus akin to one vital aspect of professional capital – decisional capital: the ability of practitioners to interpret and respond to situations effectively (Hargreaves and Fullan, 2012).

In relation to evidence informed, school led self-improvement (EISI), this paper is concerned with the factors that affect how successfully schools as organizations are able to promote and engage in research use to improve their levels of decisional capital. Specifically, we will look at what affects teachers' perceptions concerning whether their school encourages the use of research findings to support the improvement of practice and whether teachers perceive that the school improvement strategies of their school are grounded in research and evidence. We begin by looking at the role of organizational learning.

2.4: ORGANISATIONAL LEARNING

It is argued that the challenges facing EISI can only be met if school leadership is effective (Woods *et al.*, 2013). This is because it is the role of school leaders to create the most conducive conditions within their school for teaching and learning to flourish (e.g. Ross and Gray, 2006). School leader's ability to do so stems from the myriad of ways they are able to formally influence the operation and performance of schools, including the teaching and learning that occurs within them. In themselves these qualities can be divided into the 'transformational' aspects of school leadership and 'pedagogic' or instructional leadership (Day and Sammons, 2013). The former is described as a process based on increasing the commitment of those in a school to organizational goals, vision and direction (Bush and Glover, 2003) and has been shown to have positive impact in relation to the introduction of new initiatives or the remodeling or restructuring of school activity (e.g. Leithwood, 1994). The latter is seen to relate to the efforts of principals in improving teaching in their school

and their focus on the relationships among teachers, as well as the behavior of teachers viz-a-viz their work with students (e.g. Timperley and Robertson, 2011). Effective development of, engaging in and sharing of evidence informed practice within and across schools is thus likely to require school leaders to address both the ‘transformational’ and ‘learning centered’ aspects of self-improvement, and *[reference removed for peer review]* argue that to do so requires school leaders to focus on and address the following aspects of ‘organizational learning’ (OL).

The first aspect of OL concerns the existence of school cultures that are attuned to innovation. This may occur, for instance, through school leaders promoting the benefits of considering innovative ideas and normalizing the notion of experimenting with new ways of working (Leithwood *et al.*, 2006; Roberts, 2015; Galdin-O’Shea, 2015;), not least by modelling an ‘inquiry habit of mind’ (Stoll, 2015a) . That is, senior leaders actively look for a range of perspectives to help them address given issues, purposefully seek relevant information from numerous and diverse sources and continually explore new ways to tackle perennial problems.

Further aspects of OL surround supporting innovation and include the imperative for school leaders to ensure there is teacher capacity (i.e. ability) to identify, engage in and adopt effective practice, including the ability to engage in and with research activity. This involves ensuring time is made for training and increasing the skills of teachers (Roberts, 2015). Likewise, school leaders need to facilitate an environment within which new practice can be developed, trialed and evaluated (Stoll *et al.*, 2006; Datnow *et al.*, 2013; *[reference removed for peer review]*). Finally, the assumptions underpinning proposed new practices need to be made explicit in order that they can be challenged and improved (Halbert *et al.*, 2011; Schildkamp and Ehren, 2012). Correspondingly, school leaders should put in place structures so that knowledge can be shared. This includes making available and coordinating time to enable teachers to discuss new approaches to practice (*[reference removed for peer review]*).

Given the aforementioned, we hypothesize that in schools where organizational learning cultures and structures are effectively geared towards opportunities for innovation and learning, teachers are more likely to perceive that they are part of a culture that both supports and engages in the use of research and evidence (Hypothesis 1).

2.5 THE IMPORTANCE OF RELATIONSHIPS

In addition to the aspects of organizational learning (OL) detailed above, is the role of school leaders in understanding and fostering interpersonal relationships within their schools. Historically, efforts at self-improvement, including more general approaches to encouraging practitioners to become 'evidence informed' in Ontario, the USA and a number of other jurisdictions, have tended to result in mixed outcomes (Bryk *et al.*, 2011; Gough, 2013; Moss, 2013; Saunders, 2015; Hargreaves and Shirley, 2012). In part, this is because such initiatives often fail to take into account the social aspects of change as part of their implementation strategies [*reference removed for peer review*]. In other words, patterns of social interactions within and between schools are a vital component of successful school improvement (e.g. [*references removed for peer review*]).

Social relationships can act as channels for resources (such as knowledge and expertise) and also for the factors that might ensure that these resources are considered and acted upon. This notion is referred to as 'social capital', often regarded as the "resources, information and support for effective teaching available through a teacher's network" (Baker-Doyle and Yoon, 2010: 118) and which can be "mobilized when an actor wishes to increase the likelihood of success in purposive action" (Lin, 2009; [*reference removed for peer review*]). In other words, social capital represents the expressive (e.g. friendship, social activity, emotional support, trust) and/or instrumental (e.g. work-related advice or knowledge, cooperative activity such as joint lesson planning) capacity that an individual can draw on, engage with or share (or transmit) as a direct result of their position within a social relationship structure, irrespective of the formal drivers/requirements for them to do so (Borgatti *et al.*, 2013)

Access to and sharing of forms of social capital (e.g. effective practice) tend to be unevenly distributed within networks (Kelchtermans, 2006). Correspondingly, the structure of network social relations can serve both to support and constrain opportunities for both knowledge flow and creation (Inkpen and Tsang, 2005; [*references removed for peer review*]). Specifically, whether an existing network will be efficient in circulating knowledge and materials and in using these to engage in effective problem solving will be tied to the strength of its ties that relate to the 'frequency' and 'quality' of the relationships one has with others in terms of seeking or being sought for expertise. For instance, [*reference removed for peer review*] argues that high quality, high frequency ties are important to the delivery of coordinated reform efforts, since such ties may support the transfer of tacit, non-routine, and complex knowledge, allow for joint problem solving and the implementation of school level solutions (also see: Uzzi, 1997; Hansen, 1999; and Reagans and McEvily, 2003). Network scholars often use the notion of 'centrality' as an index of relational activity. Actors

(individuals) that are of higher degree centrality are those with greater number of in/out ties in general (i.e. those that both receive and share information with more other actors: Borgatti *et al.*, 2013). Correspondingly, the higher the degree centrality within a network, the more likely information (including research and evidence informed practice) will be moved efficiently and so flow to/from and reach individuals ([reference removed for peer review]; Moolenaar and Slegers, 2010).

Based on this literature, our second hypothesis is that individual teachers' degree centrality will be positively related to teachers' perceptions of their school climate as one that both supports and engages in the use of research and evidence (Hypothesis 2).

2.6 THE IMPORTANCE OF TRUST

Given the importance of social relations to the ultimate outcome of any attempts at self-improvement, it is also vital to understand what might lead to optimal relationships between practitioners within schools (e.g. see Spillane, 2015). Where social relations are steeped in high levels of trust, they are likely to improve outcomes for pupils (Bryk and Schneider, 2002; Mintrop, 2004 and Mintrop and Trujillo, 2007). In part, this is because the strength of ties amongst teachers determines whether an individual can access resources and correspondingly whether they are able to maximize their pedagogic effectiveness, and it is trust that improves the strength of these ties [references removed for peer review]. In particular, high levels of trust are associated with a variety of reciprocal efforts, including where collaboration, learning, complex information sharing and problem solving, shared decision making, and coordinated action are required (Bryk and Schneider, 2002; Bryk, *et al.*, 2010; Tschannen-Moran, 2004).

Trust between and amongst educators is supportive of the level of professional efforts related to the use of research evidence. Finnigan *et al.*, (2012), for instance, recognizing that effective evidence use is dependent on capacity (ability) to use evidence, illustrate how trust mediates between those with and without such capacity. Where teachers feel they do not have the knowledge or skills to challenge a research-informed position, trust enables a given position to be widely adopted. In addition, teachers may be more willing to engage in complex knowledge exchanges when there is a higher perceived climate of trust, which may also be associated with more collaboration (Finnigan *et al.*, 2012).

Further, *[reference removed for peer review]* argue that relations that are underpinned by trust, can form a bulwark against some of the key challenges facing self-improvement. That is, rather than respond to such challenges by playing safe and sticking to a narrow range of 'tried and tested' methods - with low trust environments thus serving to dampen innovation - in high trust schools, individuals feel supported to engage in risk taking and innovative behaviors associated with efforts at developing or trialing effective practice in a 'safe' learning environment (also Bryk and Schneider, 2002; Mintrop, 2004; Stoll *et al.*, 2006; Mintrop and Trujillo, 2007). Similarly, when individuals feel confident in taking risks with one another and being able to expose vulnerabilities they are generally better equipped to identify and voice problems, seek support and feedback, innovate, and connect to others across the organization (Bryk and Schneider, 2002; Edmondson, 2004; Moolenaar *et al.*, 2010).

The role of school leaders in facilitating a culture of trust is highlighted by Tschannen-Moran and Hoy (2000: 573) who note that "creating an organizational culture of cooperation rather than competition is likely to have a significant impact on the trusting and trustworthy behavior of participants". Conversely, *[reference removed for peer review]* caution against school leaders (in this case of schools in INI) ratcheting up the number of improvement initiatives they are engaged in order to improve their performance – either by leaving improvement status in the examples given by *[reference removed for peer review]*, or to improve their OfSTED grading in the case of England. This is because, they argue, the resulting intensification for schools to improve can negatively impact on staff morale and make these schools less attractive places to work. In turn, staff turnover often increases, meaning both that teachers do not have enough time together to normalize a trusting culture; and that school leaders can also over-regulate the working environment to compensate for the low moral/high turnover situation (in turn exacerbating it). As a result, within such schools, there tends to be diminished levels of collaboration and professional interchange and exchange *[reference removed for peer review]*.

Because of its positive impact on the way relationships function, we argue that in schools where there is a high trust environment it is likely that risk taking is encouraged and engaged in, meaning that teachers will more actively reach out to others for approaches to teaching and learning (so enhancing the volume of social capital). Correspondingly, this situation will result in increasingly complex information being shared, relied upon and used (thereby maximizing social capital). Therefore, we hypothesize that individual teachers' perceptions of a high trust environment will be

positively associated with their perceptions of school climate as one that both supports and engages in the use of research and evidence (Hypothesis 3).

3: DATA SOURCES

In response to the current policy environment and to encourage schools to 'self-improve' through the use of research, early in 2014, the Education Endowment Foundation (EEF) (a grant-making charity whose work centers on identifying and funding promising educational innovations that address the needs of disadvantaged children in primary and secondary schools in England)ⁱ opened a competition for funding for projects that would focus on increasing the use of research in schools. Specifically, the EEF sought to fund pilot projects designed to increase understanding in relation to how schools can be supported in applying existing research findings to improve outcomes and narrow the gap in pupil outcomes. To address the EEF's aims the first author of this paper proposed a project ('Research Learning Communities') that would focus on addressing the aspects of organizational learning described in Section 2.2. In addition, the project sought to use an innovative approach to circulating knowledge within schools through Social Network Analysis that would be employed to find potential central actors within schools who were in favor of the idea of research-informed practice, and employing these people to act as research 'champions'.

Given EEF's mandate to invest only in proven initiatives, they stipulated that the project must be independently evaluated and that in order to assess its impacts effectively the pilot must be construed as a randomized control trial (full detail on the evaluation including its methodology can be found in Rose, 2014). Accordingly, our initial proposal was to recruit 110 primary schools across England, with half forming Research Learning Communities (RLCs) (made up of ten groups of five to six schools) and half forming the control group. Schools were recruited by the research team through use of twitter, the direct contacts of the project team and via direct mail (e)mailing lists held by the UCL Institute of Education's London Centre for Leadership in Learning. Schools were invited to sign up to the project straight away, to discuss the project and any queries directly with the PI (the lead author) or to attend one of two recruitment events held in June 2014. Ultimately 114 schools indicated that they wished to take part and were also eligible to do so. All 114 schools proceeded to the next stage of the project, which involved the evaluator and UCL Institute of Education teams working together to determine how the 114 schools should be allocated into RLC intervention and control groups. In the end 58 schools formed the treatment group and 56 the control.

3.1: RESEARCH QUESTIONS

Although the use of research and evidence may now be viewed as a fundamental aspect of school self-improvement, we argue that the successful and meaningful use of research and evidence within schools will depend, first, on the organizational learning cultures and structures that exist in relation to supporting research use; second on the frequency and quality of the social ties that exist within school, which are likely to impact on the extent of expertise seeking behaviors and also the flow of information between teachers and around the school; and third on the levels of trust within a school that will affect both the quality and structure of social ties and the effects of OL (Spillane, *et al.*, 2006; [reference removed for peer review]). To date the relationship between aspects of research-informed self-improvement, social networks measures (such as the frequency and quality of ties) and aspect of OL, social capital such as trust, have not been explored in any significant detail in schools in England. Because its focus was on using central actors to drive school improvement, however, the Research Learning Communities project provides a unique opportunity to investigate what factors impact on teachers' perceptions that their school has a positive research/evidence use climate. Specifically, defining the research use climate as teachers' perceptions that they are encouraged to use research and evidence to improve practice, and their perceptions of whether the school improvement strategies of their school are grounded in research and evidence, we set out to explore:

- **Research question 1:** to what extent do teachers' perceptions of the presence of *organizational learning* factors within their school affect their perceptions of the school's research/evidence use climate?
- **Research question 2:** to what extent are perceptions of the research use climate positively related to the *frequency and quality of the expertise seeking interactions* reported by teachers?
- **Research question 3:** what impact do perceptions that they are working in a *high trust environment* have on teachers' perceptions of the research/evidence use climate within their school?

4: METHODS

This study, part of the larger RLC project, aims to enhance our understanding of teachers' perceptions of their school's climate in relation to using research/evidence, and key factors that may be associated with their perceptions. We employ a combination of analytic methods to test our hypotheses about the relationship between OL, professional relationships, trust, and climates of research/evidence-informed practice. Our survey instrument was used to gather data that measure

OL, trust, and research/evidence use ('RE Use') climate from 828 teachers of 43 schools. Social network data and analysis are used to quantify teachers' professional relationships in relation to expertise seeking behaviors. We then use hierarchical linear regressions to explore the multilevel relationship between study variables in order to take into account the nested nature of our data (Raudenbaush *et al.*, 2004). Finally, we provide social network diagrams of professional relationships using social network software as a way to visualize the pattern of relationships between teachers and among study variables.

4.1: SAMPLE

A social network survey was administered to all teaching staff within schools, including school leaders, classroom teachers, instructional support staff, etc. As this study aims to explore teachers' professional practice in relation to the use of research/evidence, we focus our work on teacher participants whose primary responsibility is teaching. A total of 828 teachers from 43 schools participated in the survey, resulting in an average response rate of 75%. Table 1 provides the overall demographics of the participating teachers from the 43 schools. As can be seen, schools involved had on average some 320 students (SD = 194.4) with approximately 19 teachers per school (SD = 10.5). The average schools' OfSTED grade is close to the accountability outcome level of "Good" (SD = 1.2). As for teacher data, of all the 828 teachers, 82% are female; approximately 49% serve as a subject leader (e.g., math lead or coordinator; and about 18% hold a formal and senior leadership position (e.g., headteacher). On average, the teachers have less than four years of experience working in their current position.

Table 1: Sample Demographics

	Mean or %	SD
School level		
Number of teachers	19.00	10.50
Number of students	320.00	194.38
OfSTED	2.86	1.17
Teacher level		
Years in current position	3.56	3.71
Gender (female)	82.0%	--
Serve as a subject leader	49.0%	--
Hold a formal senior leadership role	18.0%	--

It should be noted that the nature of the sample does bring with it a number of caveats in relation to how our analysis can be interpreted. First, all 43 schools involved are primary schools, so no

inference can be made about this analysis and England's 3,200+ secondary schools. Second, it is possible that the schools involved are more predisposed to research engagement than the majority of England's primary schools.²

4.2: DATA COLLECTION AND INSTRUMENTATION

The data were collected during autumn of 2014 using a social network survey. The data include perception scales (i.e., OL, trust, and RE Use climate) and demographic background, as well as social network data that capture the professional relationships teachers engage in in order to share or obtain teaching and learning expertise. We first present the technical aspects of the survey scales, followed by the management of the social network data.

4.2.1: RE Use climate. The RE Use climate scale was adapted from a previous study (see [reference removed for peer review]) and is composed of three items on a 5-point Likert type scale, which ranges from 1 (strongly disagree) to 5 (strongly agree). The construct measures participants' perceptions as to whether school cultures are geared towards research use, both in terms of whether teachers felt encouraged to use research and evidence, and whether they perceived the improvement strategies of their schools to be grounded in research and evidence. For example, a sample item from the scale is: "my school encourages me to use research findings to improve my practice". We conducted the principal component analysis and reliability test for internal consistency of the RE Use Climate scale. The PCA result in a single factor solution explaining 63.3% of the variance with Cronbach's alpha of 0.71.

4.2.2: Organizational learning (OL). The OL scale was drawn from a previously validated instrument and further modified to fit the study context (see [reference removed for peer review]; Garvin *et al.*, 2008; [reference removed for peer review]). The OL scale is composed of six items, on the same 5-point Likert type scale, and measures schools': capacity, cultures, learning environments as well as their structures, systems and resources. A sample item is: "this school experiments with new ways of working".

We conducted the principal component analysis and reliability test for internal consistency of OL scale. The PCA result in a single factor solution explaining 62.2% of the variance with Cronbach's alpha of 0.88.

² 20 of the schools in our sample were in a Teaching School Alliance, where there is a formal commitment to engage with research and development and another 20 were attempting to enter a research alliance.

4.2.3: Trust. We drew from instruments validated in previous studies that examine trust in colleagues (see Hoy and Tschannen-Moran, 2003; [reference removed for peer review]) and further modified to fit the study sample and context. The trust scale consists of six items, on the same 5-point Likert type scale, measuring teachers’ perceptions as to the levels of trust within their school. For example, by asking respondents to indicate the extent to which they agree with statements such as: “staff in this school trust each other”. The PCA result in a single factor solution explaining 52.9% of the variance with Cronbach’s alpha of 0.82.

The items and factor loadings of the PCA results for each of the constructs are summarized in Table 2.

Table 2: Items, Factor Loadings, and Reliability (Cronbach’s alpha) of the Study Scales

Item	Factor loading
RE Use Climate (alpha = .71)	
My school encourages me to use research findings to improve my practice.	.81
Research and evidence is used to inform staff here about potential improvement strategies.	.81
Staff at my school use research and evidence to stimulate conversation/dialogue around an issue.	.77
Climate of OL (alpha = .88)	
This school experiments with new ways of working.	.84
In this school, people value new ideas.	.83
In this school time is made available for education/training activities for school staff.	.79
This school has a formal process for evaluating programs or practices.	.78
This school has forums for sharing information among staff.	.75
This school frequently discusses underlying assumptions that might affect key decisions.	.74
Climate of Trust (alpha = .82)	
When middle leadership in this school tell you something you can believe it.	.77
When teachers in this school tell you something you can believe it.	.77
Staff in this school respect each other.	.75
Staff in this school trust each other.	.72
When senior leadership in this school tell you something you can believe it.	.70
People in this school are eager to share information about what does and doesn't work.	.64

4.2.4: TLE Network Relation. In terms of the social network data, we asked participants to assess the *frequency* of interactions with other colleagues of their school “to whom do you turn as reliable sources of expertise in terms of teaching and learning” on a 5-point scale ranging from from 1 (1-2

times a week) to 5 (Not at all). We refer this social network relationship as the Teaching and Learning Expertise (TLE) Network. In addition to the frequency of their TL-related interactions, we also asked participants to assess the *quality* of such interactions by reflecting the degree of usefulness on a 5-point scale, ranging from 1 (Not at all useful) to 5 (Very useful). Participants within each school received a roster with teachers from their schools in rows and the frequency of interactions for each relationship in columns. The number of nominations from the bounded list of nominees that participants could make was unlimited. This bounded method is a social network strategy that provides a more complete picture of the network and thus supports valid results (Scott, 2000). We extracted ties recorded as being more frequent ('a few times a month' to '2-3 times a week') and more useful ('useful' to 'very useful') as participants are more accurate at identifying ongoing patterns of interactions than determining interactions that occur occasionally (Carley and Krackhardt, 1999). These more frequent and stable interactions may also reflect stronger ties that are likely to transmit complex information (Krackhardt, 2001).

Importing the social network data into UCINET (Borgatti et al., 2002) software program, we then calculated a series of social network measures to indicate the degree of connectedness an individual teacher has in their school's TLE network. Specifically, we calculated *degree* centrality for both types of interactions (e.g., frequency and quality of interactions) to determine the amount of ties an individual teacher possesses with their colleagues in the school TLE network. It should be noted that the ties are non-directional, meaning any tie that involves both seeking TL expertise *and/or* being sought for such expertise is counted as that individual's degree of connection. In other words, an individual teacher's TLE *degree* refers to the total number of teachers with whom that teacher is connected for seeking, receiving, or exchanging information for teaching and learning. In this study, we focus on non-directional ties, as opposed to directional, because we attempt to first explore whether engaging in interpersonal relationships in regard to teaching and learning and the quality of these interactions, if any, are associated with the overall RE Use Climate perceived by teachers. This exploratory understanding provides much analytic purchase enabling us to decide a follow-up analytic strategy. The present study examines degree centralities for two types of network relations: one is the TLE degree of the amount of weekly interactions (TLE degree – weekly interaction) and the other is TLE degree of the usefulness of interactions (TLE degree – usefulness of interaction). The TLE degree – weekly interaction indicates the number of interactions a teacher has with others regarding teaching and learning on a weekly basis. The TLE degree – usefulness of interaction refers to the number of quality interactions a teacher has with others that are regarded as useful and very useful.

For our analysis, we computed normalized degree centralities for the two types of interactions within teachers' school networks to account for the variation in network size. Normalized degree centrality reflects the actual actor degree as a percentage, and can vary on a scale of 0 (the teacher has no interpersonal relationships and occupies a marginal position in the school TLE network) to 100 (the teacher initiates all the ties in the school TLE network and occupies a highly central position). Furthermore, as social network data is typically not normally distributed, for the network measures of degree centralities, we computed three categories for our analysis: no ties, mid range, and high, each representing roughly a third of the population. These categories provided us with the ability to address assumptions of normal distribution in the sample and compare among teachers with different levels of social capital. Other works that have applied data transformation strategies to social network data can be found in [reference removed for peer review] and Plotkowiak's (2014).

4.3: VARIABLES AND DATA ANALYSIS

As this study attempts to explore whether teachers' perception of their school's RE Use climate is associated with other factors, our dependent variable is RE Use Climate and independent variables are teachers' perceptions of OL, Trust, and individual teachers' TLE degree centralities (both TLE degree – weekly interaction and TLE – usefulness of interaction). The TLE Network variables require further attention as social network measures tend to be highly correlated (Christley *et al.*, 2005), and thus we treat each degree centrality separately in our models in order to address the issue of multicollinearity. In addition, we included several control variables in our initial model, such as the school size in terms of the number of teaching employees and teachers' gender and years of experience (Baker-Doyle and Yoon, 2010; [reference removed for peer review]).

Our analytic strategy was threefold. First, we provided descriptive and correlation statistics to obtain an initial sense of the relationships between study variables. Second, we applied a multilevel analysis to test our hypotheses. We started with an unconditional model that yielded an initial intraclass correlation coefficient (ICC) of 26.3%, reflecting that at least 26% of the variability in the outcome variable (e.g., teachers' perception of RE Use Climate) occurred between schools, and as such indicated a hierarchical structure of the data. We continued the model building process by first including teacher demographic variables as fixed effects in a level-1 model with random intercept to examine the relationship between demographics and perceptions of RE Use Climate, controlling for school level variance. This resulted in a significantly improved model. We then added teachers' perceptions of Trust and OL as fixed effect in order to test the relationship between these variables

and their perceptions of RE Use Climate, yielding significantly improved model fit. We then added these variables as random effects in order to determine if their influence on perceptions of RE Use Climate varied among schools. The model did not yield a significant improvement, suggesting the perceptions of Trust and OL did not significantly vary by school. We added TLE degree centrality one for each model as a fixed effect to examine the relationship between centrality and teachers' perceptions of RE Use Climate, yielding two separate significantly improved models to answer our second research question. Finally, we tested whether the TLE degree centralities varied across schools, and the models suggested a non-significant improvement in model fit. We estimated our models using maximum likelihood. To test the improvement in model fit across all models, we used the likelihood ratio test by examining differences in the -2 log likelihood values of nested models. We also reported both Akaike's Information Criterion (AIC) and Bayesian Information Criterion (BIC) to provide more versatile measures (McCoach & Black, 2008). The best fitting models are displayed in Table 4. Finally, we generate two social network diagrams from two schools that represents the contrasting cases of RE Use climate and pattern of TLE network connections.

5: RESULTS

5.1: Descriptives and Correlations

Table 3 presents the descriptive statistics and correlation matrix of the study variables. In general, teachers perceive the climates of their school as being driven by the use of research evidence, trusting, and learning oriented (mean ranging from 4.4 and 4.7). In terms of professional relationship, teachers are connected with an average of 56% of other colleagues for expertise around teaching and learning (mean = 55.9, SD = 31.5) on a weekly basis. In addition, of all the connections individual teachers have around teaching and learning, 45% of the ties are regarded as either useful or very useful (mean = 44.8, SD = 29.1). The correlations indicate that Trust and OL are both statistically significantly and positively correlated with RE Use Climate ($r = .31$ and $.15$, $p < .01$, respectively). This suggests that teachers who perceive their school climates as being trusting and learning oriented are thus more likely to also perceive a collective norm around the use of research evidence in practice across the school. Moreover, there is a statistically significant and positive, although weak, relationship between both TLE degree centralities and RE Use Climate ($r = .13$ and $.18$, $p < .01$), suggesting that teachers who are connected with more other colleagues around teaching and learning expertise (as determined by their response to the question "to whom do you turn as reliable sources of expertise in terms of teaching and learning") and who have more useful

connections around teaching and learning are more likely to perceive their school climate as being shaped by the use of research evidence.

Table 3: Descriptive Statistics and Correlation Matrix

	Mean (SD)	Correlation matrix			
		1	2	3	4
Climate of RE	4.47 (0.71)				
Climate of Trust	4.69 (0.53)	.31**			
Climate of OL	4.35 (0.88)	.15**	.15**		
TLE degree - weekly interaction	55.93 (31.48)	.13**	.20**	.04	
TLE degree - usefulness of interaction	44.77 (29.07)	.18**	.25**	.03	.82**

Note: Degree centralities reported in this table are normalized in a form of mean percentage.

5.2: Relationships between RE USD Climate and OL, Trust, and TLE Degree Centralities

Table 4 provides the final models of our multilevel analysis. The first model, added significantly to the demographic-based model (χ^2 change(2) = 76.18, $p < .01$), examines the relationship between teachers' perceptions of Trust and OL and their perceptions of School's RE Use Climate, controlling for school's staff size, teachers' gender and years of working in their current position. The first model show that a statistically significant amount of variance in individual teachers' RE Use Climate is attributed to the school level (intraclass correlation coefficient for RE Use Climate, ICC = .27), indicating that 27% of the variability in teachers' RE Use Climate perception occur between schools even controlling for demographical variables. Confirming hypothesis 1 and 3, our findings indicate that teachers' perceived climates of Trust and OL are statistically significantly and positively related to their perceived school's RE Use Climate. That is, teachers who report their school to have high levels of trust and are learning oriented also tended to report that their school engaged in activities that are supportive of research/evidence informed practice.

In the second and third models, we add degree of weekly interaction and degree of useful interaction, respectively, to examine the relationship between degree centralities and perceived RE Use Climate. Model 2a and 2b each added significantly to the first model (χ^2 change (1) = 5.88, $p < .05$, χ^2 change (1) = 9.54, $p < .01$, respectively), and shows a statistically significant amount of variance in individual teachers' RE Use Climate that is attributed to the school level (ICC = .24 and .23, respectively), with the remaining large portion of variability attributed to the teacher level (76% and 77%, respectively). The findings, confirming hypothesis 2, indicate that in addition to the significant predictors of Climate of Trust and OL, both types of degree centralities are significantly and

positively related to the perceived School’s RE Use Climate. In other words, teachers who have more weekly interactions with other colleagues for teaching and learning as well as a greater number of useful connections for teaching and learning tend to report higher levels of school-wide instructional activities that are research-based. For all models, no statistically significant difference is found in gender and years of experience.

What also emerges from the analysis, however, is that of all the variables for RE Use Climate, perceptions of trust is by far and away the biggest driver of perceived research use: with a range of β sizes ranging from 0.28 to 0.25. The Trust variable has approximately three times more significant weight on the RE Use Climate perceptions than OL (β around 0.08). It can also be seen that while the frequency and the quality of interactions are important, it is the regularity of interactions that has more impact on perceptions of research use, as compared to the usefulness of interaction. This highlights the importance of school leaders attending to both the formal and informal aspects of evidence-informed practice/evidence informed school improvement EIP/EISI. Although OL does positively impact the degree to which teachers perceive the use of RE Use climate within their school, it is the level of trust, that is more strongly associated with how staff in engage in OL and how they respond and interact with each other informally. Trust appears to be main driver around teachers’ perceptions that they operate within an environment both employing and encouraging the employment of research and evidence.

Table 4: Parameter Estimates from Two-Level Models in School's RE Use Climate

	Model 1	Model 2a
Fixed effects		
Intercept	.033	-.253
Gender (male)	.058	.045
Years in current position	-.006	-.006
Climate of trust	.280 ***	.262 ***
Climate of OL	.083 *	.083 *
TLE degree - weekly interaction		.043 *
TLE degree - usefulness of interaction		
Random effects		
Error variance		
Level-1	.611 ***	.607 ***
Variance		
Intercept	.196 **	.187 **
Model fit		

-2 Log Likelihood	1595.337	1589.462	
AIC	1609.337	1605.462	
BIC	1640.697	1641.302	
	X ² change (2) = 76.184 (p<.01)	X ² change (1) = 5.875 (p<.05)	X ² cha

Note: Unconditional model ICC = 0.263. Demographic-based model: ICC = 0.270, -2 Log Likelihood = 1671.521. N=43 school, 828 teachers.

*p < .05, **p < .01, *** p < .001.

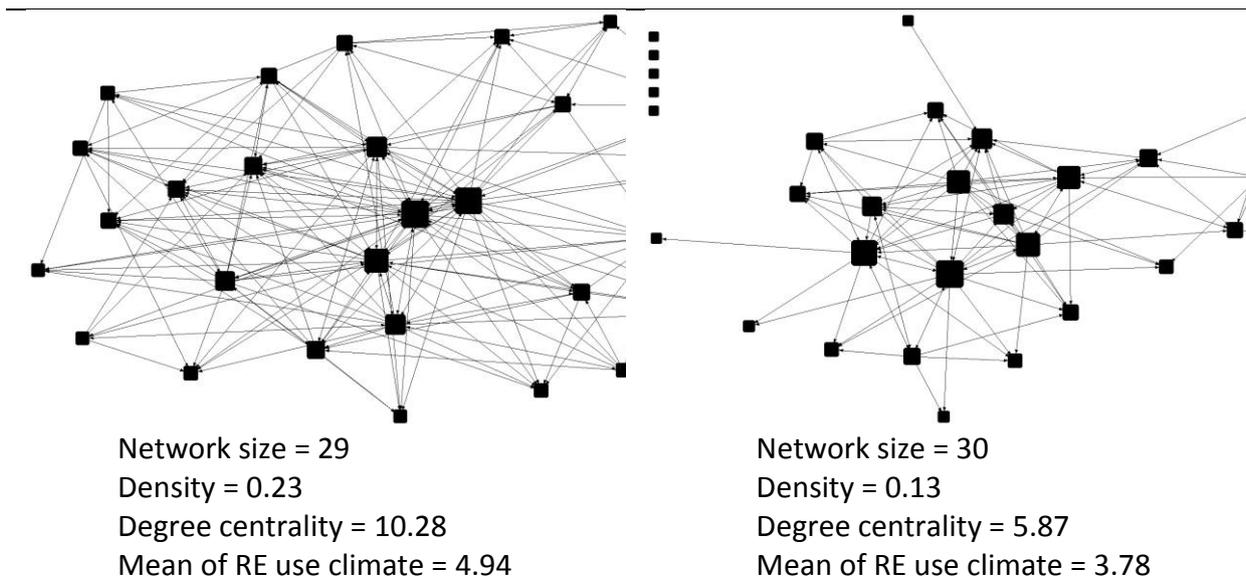
5.3: Network Diagrams in Relation to RE Use Climate and TLE Network Connections: Two

Contrasting Cases

In addition, we provide two network sociograms from two sample schools as an illustrative example of the study findings (see Table 5). We focus on the relationship between the outcome variable (RE Use Climate) and TLE degree centralities. The two sociograms indicate that the school with a higher RE Use climate (School A) also tends to exhibit professional connections regarding exchanging expertise in teaching and learning that are relatively more dense and of greater average degree of than the school with a lower RE Use climate (School B) (density = 0.23 vs. density = 0.13; while degree centrality = 10.28 vs. degree centrality = 5.87). Individual teachers at the school with a lower RE Use climate are either connected with fewer or no colleagues in terms of exchanging teaching and learning expertise, as compared with those at school with a higher RE Use climate. This finding between teachers' frequency of professional interaction and their perception of school's RE use climate corroborates the statistical analysis displayed in Table 4. In other words, teachers who perceive their school's climate as being more oriented to the use of research/evidence in practice tend to frequently exchange expertise regarding teaching and learning with more colleagues than teachers who perceive a lower level of RE Use Climate. Such pattern of relationships between outcome variable and the other study variables (Trust, OL, and usefulness of interaction) also are reflected in other sociograms we prepared for the study.

Table 5: Comparison of School Network Sociograms between Higher and Lower RE Use Climate

More RE Use Climate Sample School A	Less RE Use Climate Sample School B
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Note: Nodes represent teachers from each school TLE network. Lines represent frequent connections between school members. The nodes are sized by degree centrality.

Table 6 summarizes the study hypotheses, all of which were supported. First, our analysis indicates that educators who reported the climate of their schools to be focused on learning, experimentation, and valuing of new ideas tended to also report more use of research/evidence. Secondly, we found that teachers who had more frequent and useful interactions around teaching and learning also reported more research/evidence use in their schools. Finally, higher levels of perceived trust in the school were also associated with reporting higher levels of research/evidence use. Taken together this work suggests that there are important learning and relational conditions that support the use of research/evidence. This work has thus enabled us to move beyond the technical aspects of supporting research/evidence to bring into better focus the importance of social ties and the quality of those relations for increasing the use of research/evidence.

Table 6: Summary of Hypotheses and Findings

Hypothesis	Results	Findings
H1: In schools where organizational learning cultures and structures are effectively geared towards evidence use/EISI, teachers are more likely to perceive that they exist in a culture that both supports and engages in the use of research and evidence.	Supported	Teachers who reported their school climate to be learning oriented tend to also report higher scores on RE Use Climate.
H2: Perceptions by teachers of research use in their schools will be positively related to the quality and frequency of professional interactions within the school.	Supported	Teachers who possess more frequent and useful interactions around teaching and learning expertise with other colleagues tend to also report higher scores

on RE Use Climate.

H3: A high trust environment is likely impact positively on perceptions of research use at the school level.

Supported

Teachers who reported their school climate as a trust environment tend to also report higher scores on RE Use Climate.

6: SIGNIFICANCE

The RLC project, and its incumbent use of Social Network Analysis to examine who within schools might be best suited to drive research/evidence informed self-improvement is the first of its kind in England. But the study also provides vital and new perspectives on the role of trust in achieving self-improvement. Based on our theory of action for the analysis (as espoused in our hypotheses) we argue that our results illustrate the importance of learning and trust in facilitating the types of relations needed to provide teachers with access to the research/evidence centered social capital that resides within a school. The work expands our notions of what is necessary to support the use of research/evidence in schools by placing more relational elements of the improvement equation front and center (i.e. it builds on the work of the work of *[references removed for peer review]* by directing it at research use).

Our data confirms suggestions made by *[reference removed for peer review]* that organizational learning is positively associated with research/evidence use. In part this is because some OL items (such as question 6: ‘in this school time is made available for education/training activities for school staff’) may be foundational to the capacity (ability) to engage in research, while others correspond to the structures required to effectively share information around an organization (e.g. question 7: ‘this school has forums for sharing information among staff’). It also substantially augments this work. It is probably the case that when teachers are provided opportunities try new approaches, they are more likely to collectively develop a norm of sharing practice/ideas, which in turn facilitates the shaping of climates driven by such norms.

High levels of trust may also facilitate teachers acting upon the OL messages they receive from school leaders: in other words with trust comes both belief that it is OK to try something new and a more concerted effort to do so. Enhanced relationships that stem from the existence of trust operate within the direction and purpose of an OL effort (itself guided by a transformative vision), may be more to lead to the specific attainment of goals such as EIP/EISI. We argue therefore that

our findings add to existing literature on leadership (e.g. Bush and Glover, 2003; Day and Sammons, 2013) by illustrating the role of fostering within-school trust as being vital to school improvement. In addition, it is likely that across school systems, the presence of organizational learning climate and, as our study would suggest, teachers' ability to use research (as might be facilitated by OL factors) is likely to be variable. We might speculate that high levels of trust may act to reduce the "uncertainty" when interacting with others and new material. High trust levels may in effect reduce the "transaction costs" that are present when one learns and uses new practices. In other words, if I perceive a high level of trust in my school I may be more likely to try new practices without fear of humiliation or reprisal.

Across our sample, our findings also indicate that higher levels of trust were significantly associated with more frequent (and useful) ties that may result in a variety of relational efforts, including collaboration, learning, complex information sharing and problem solving, shared decision making, and coordinated action: i.e., actions essential to the development of new and effective practice informed by research and evidence. This idea, supported in research related to communities of practice (Wenger, 1998), suggests that opportunities to interact and learn together in trusting communities are important in systems oriented toward learning. Importantly, high trust relations provide opportunity to modify and deepen relationships and practice, which may be thought of as a process of learning, (Lave and Wenger, 1991). Our work is unique in that it addresses not only the improvement efforts in relation to the quantity of ties (who is connected to whom), but also the quality of those interactions. The leadership question here is how and in what ways do leaders create and nurture the conditions for high quality ties to form specifically around the important work of using research/evidence for improvement.

Reflecting the work of Hargreaves and Fullan (2012), overall our analysis implies that in order to achieve one vital aspect of professional capital – decisional capital (and so the incumbent benefits associated with EIP as set out in section 2.2) schools need to facilitate (1) the research-centered knowledge of practitioners and their ability to engage with research and evidence (human capital driven by OL); and (2) effective, quality relationships steeped in trust (social capital) with human and social capital working to positively reinforce one another. We do not view social capital as a supplanting of human capital approaches, but rather a supplement to important human capital dimensions. To harness the power of power of professional capital in schools, leaders must find the strength to be bold and supportive of trusting relational conditions in the face of external demands and challenges.

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