Improving Interaction in Teacher Training Programs:

Rise of the Social Dimension in Pre-service Teacher Education

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Abstract

This paper claims to study the social side of pre-service teacher education, and draws on Social Network Analysis (SNA) to explore the relation between their social capital and their academic and professional success. An online survey was applied to a sample of 321 students enrolled full time either in Preschool Education or Primary Education programs. The instrument consisted of a combination of social network questions and a rating scale attributes. Findings allow us to understand the relationship between aspects of the cohort's social network and key development constructs and show us the importance of considering the informal interaction within the program to improve pre-service teachers' performance.

Keywords: pre-service teacher, social network analysis, social capital, academic and professional success, teacher competencies.

Introduction

The global challenge of improving educational system is certainly related to the improvement of teacher training, what means to improve the educational system as a whole (Liou et al., 2016; Piqué, Comas & Lorenzo, 2010; Vaillant & Manso, 2013). Often, efforts to improve the training of teachers in our universities have focused on specific aspects such as the curricula, the consistency and grading of university courses or the involvement of students in schools. In Catalonia, there were several programs that aim to improve the educational system through the focus on teacher training education (MIF program, Catalonian Government, Spain). Recent research suggests that it becomes especially effective to focus on building teacher skills and competencies as knowledge content, pedagogical approaches, management, curriculum

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development, planning and evaluation (Beyer & Davis, 2012; Monte-Sano, 2011; Nelson & Sassi, 2000; Nilsson & Loughran, 2012; Shulman, 1986). Also, socio-cognitive competencies that facilitate qualitative interaction between the educational community members have emerged as relevant, encouraging the creation of social capital and facilitating the achievement of educational challenges faced by teachers in the 21st century (Johnson, Birkeland & Donaldson, 2004; Smethem, 2007). Thus, initial teacher education must create learning environments based on cooperative culture constituted on social and academic support (Johnson et al., 2004; Smethem, 2007; Liou et al., 2016; Dika & Singh, 2002; Lin, 2001; Daly, Moolenaar, Bolivar & Burke, 2010).

The concept of social capital has been used in education and has been connected to a variety of positive outcomes such as educational attainment, academic achievement and psychological factors (Dika & Singh, 2002). However, there are few studies that investigate the social side of pre-service teacher related to their both academic and professional achievement (Liou et al., 2016). In this context, by "greater social capital" we are referring to one of the most important measures of network centrality (Wasserman & Faust, 1998): degree, the number of ties a pre-service teacher give or receive to or from other pre-service teachers; and betweenness, meaning the degree to which a pre-service teacher occupies a position between other disconnected pre-service teachers. The position of pre-service teachers as well as the social network structure can facilitate or inhibit access to social capital.

In this paper we discuss the impact of pre-service teachers' relationships between classmates in their learning and professional development, arguing that connected ties in their networks can support and develop a multidimensional approach to learning, but also empower a social dimension of teacher education. Thus, we aim to study how the social dimension of pre-service teachers' education can be structured and facilitated to improve professional competencies within university program.

Concretely, this study focus on pre-service teachers' relationships related to the networks of advice, need to vent and new ideas. The instrumental advice network is important for student achievement, reflecting the exchange of work related information and knowledge (Moolenaar & Sleegers, 2010; Smith & Peterson, 2007). Therefore, being central in the advice network reflects an individual's involvement in exchanging resources in the process of problem solving, accumulating information, knowledge, and experiences about task-related problems, and thus is

likely to perform better (Yang & Tang, 2003). Otherwise, the expressive need to vent network contains the flow of affective and emotional resources that pre-service teachers had when they need to talk with their peers about problems or worries. Consequently, a central position in this network provides a greater chance of helping other and being helped in an emotional sense. Then a student is also likely to perform better with this support. Both networks have in common that represent interaction relations (Daly, 2010). On the other hand, a flow relation is included through the instrumental network new ideas, which has a clearly orientation towards innovation (Moolenaar et al., 2010; Kogut & Zander, 1992; Paavola, Lipponen, & Hakkarainen, 2004). Thus, students who are central in this network possess new knowledge and information and they are willing to try new ideas and to take more instructional risk, so they are likely to perform better.

In light of the literature, our study is guided by the following hypothesis:

H1: Centrality measures in pre-service teachers' social networks (advice, need to vent and new ideas), as an indicator of greater social capital, are positively related to academic success (Grade Point Average: GPA).

H2: Centrality measures in pre-service teachers' social networks (advice, need to vent and new ideas), as an indicator of greater social capital, are positively related to better professional competences (Practicum Grade and Perception of Self-Efficacy).

Therefore, our study is focused on understanding the impact of social capital in education, regarding the initial training of pre-service teachers and the achievement of their academic and professional success.

Theoretical framework

Social network theory and analysis

Social network theory builds on the idea that social resources such as knowledge, information and expertise are exchanged through informal networks of relations between actors in a system. A fundamental element in this theory is concerned with the pattern of social tie that exists between actors in a social network that creates an overall social structure (Scott, 2000).Therefore, social network structure refers to the overall pattern of social relations across a network that may support or constrain the access of the resources (Lin, 2001; Wasserman &

Faust, 1998). It exists a typology of ties that could be differentiated depending on this nature if its social relations (kinship or other role), interactions (talked to, advised…) and flows that are transmitted through interactions (information, ideas, belies…) (Borgatti, Mehra, Brass and Labianca, 2009; Daly, 2010).

The Social Network Analysis provides a new relational perspective based on the fundamental concept of the "network" that consists of a set of nodes or actors (persons, teams, departments, organizations...) with a set of ties of a single type that connect nodes (Daly, 2010; Kilduff & Tsai, 2003). Related to the characteristics of a network, in social literature it exists a distinction between instrumental and expressive networks (Ibarra, 1993; Lin, 1982). Instrumental networks are more related to work role and academic performance, involving the exchange of information, knowledge, advice and instructional material resources. Meanwhile, expressive networks are focused on the transfer of more affective and emotional resources such as need to vent and friendship. These expressive relationships contain a high level of trust involved, compared to the instrumental networks, and tend to be more stable over the time (Ibarra, 1993; Uzzi, 1997).

This perspective moves from a primary focus on the individual and the attributes of an actor to the more dynamic supports and constraints of the social structure (Borgatti & Foster, 2003; Cross, Borgatti, & Parker, 2002; Wellman & Berkowitz, 1998).Therefore, the main focus in a social network perspective is the relationship between actors that are embedded in the network that constrain or provide opportunities depending on the position of the nodes in the networks (Daly, 2010). Position in a network refers to an actor's location in a social structure that affects the access to resources and it is determined by the outgoing and incoming ties that surround an actor (Daly, 2012). Consequently, an actor who occupies a central position in the network receives a higher proportion of interactions than other (Scott, 2000). Therefore, a central position provides the actor with the opportunity to easily access to more resources and the possibility to control the flow of resources, increasing their effect overall the network. In contrast, peripheral or isolated positions receive and provide fewer interactions and resources, so they have less influence in the social structure (Daly, 2012).

Social Capital

Social capital is one of the basic theoretical foundations in understanding social networks. This concept is generally defined as the resources embedded in social networks which can be

accessed or mobilized across the network through a purposive action (Lin, 1999). Theorist of social capital share the general understanding that social capital resides in the resources that exist in the relationships rather than possessed by an individual. So, investing in relationships can increase social capital for meeting both individual and collective goals (Liou & Daly, 2014; Coleman, 1990).

The interest towards the concept of social capital was promoted by the theories of the sociologist Bourdieu (1986) and Coleman (1988) at the end of the 80s. Both authors highlight the importance of social networks in the conception of social capital. Bourdieu (1986) wrote about the interaction of the three fundamental sources of capital: economic, cultural and social. Social capital was defined as the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships. Additionally, Bourdieu (1986) proposes that the volume of social capital possessed by an agent should depend on the size of the network of connections that he can effectively mobilize as well as the volume of the capital (economic, cultural or symbolic) possessed by each to whom he is connected. Thus, Bourdieu's explanation of social capital is decomposable in two elements: the social relationship that allows the individual to claim resources possessed by the collectivity and the quantity and quality of those resources (Portes, 1998). On the other hand, Coleman's (1988) interpretation of social capital is based on norms and social control and adopts three forms: levels of trust (evidenced by obligations and expectations), information channels, and norms and sanctions that promote the common good over self-interest. Coleman (1988) focused on the role of social capital in the creation of human capital, making a distinction between these two concepts. Human capital is created by changes in persons that bring about skills and capabilities that make them to act in new ways. Meanwhile, social capital is about the changes in the relations among persons that facilitate action. For human capital, the person who invests time and resources in building up this capital, receives a personal benefit. However, for social capital, the benefit is for all who are part of this structure. Later on his work focused on the role of parental involvement in developing social capital, so his work is usually cited in support of a particular kind of community (Dika & Singh, 2002).

Putnam (1995) is another referent in the development of the concept that defines social capital as the three characteristics of the social organization: networks, norms and trust that facilitate coordination and cooperation and the mutual benefit. Moreover, a great number of authors have

written on social capital, such as Granovetter (1973), Fukuyama (2001), Portes (1998), Burt (2004) and Lin (1999). Granovetter (1973) defines the strength of a tie as the combination of the amount of time, the emotional intensity, the intimacy and the reciprocal services, arguing that one's strong ties form a dense network and one's weak ties a less dense one, but essential for the community integration. On the other hand, Fukuyama (2001) defines the social capital as instantiated informal norm that promotes co-operation between two or more individuals. Portes (2000) saw the concept of social capital as one of the most successful "exports" from sociology to other social science such as anthropology, business, economics, education, development/planning and political science. Meanwhile, Burt (2004) highlights the advantage of an actor location in a social structure and the social capital of brokerage, as the between-group brokers are more likely to express ideas. Therefore, people whose network bridge the structural holes between groups have more access to variety information and in translating information across groups. Finally, Lin (1999) argues that social capital is captured from the embedded resources in social networks. Then, social capital is rooted in social networks and social relations and it contains three elements of structure and action: the structural (embeddedness), opportunity (accessibility) and action-oriented aspects.

Social networks and teacher competencies

Many approaches to reform practices call for the innovative approach across social and cognitive aspects in education with the principal focus on the collaboration efforts in school (Daly, 2010; Schechter, 2005; 2010; Moolenaar, Sleeegers & Daly, 2012). Recently, it has been an increasing interest in teacher's social networks to better understand the role of teacher interaction in policy efforts at educational reform (Coburn & Russell, 2008; Daly et al., 2010). Therefore, social network theory has the potential to approach social processes involved in educational reforms (Daly, Moolenaar, Liou, Tuytens & del Fresno, 2015).

Different studies suggest the importance of teacher collaboration networks for building teacher capacity and student achievement (Moolenaar et al., 2010; Daly & Finnigan, 2010; Penuel, Riel, Krause & Frank, 2009). Moreover, studies on teacher collaboration highlight the role of educators' interactions in improving the quality and effectiveness of teaching practices and school organizations (Goddard, Goddard & Tschannen-Moran, 2007; Moolenaar, Daly &

Sleegers, 2011; Yasumoto, Uekawa & Bidwell 2001). The role of social networks in teacher professional development can also provide professional support and share of knowledge in an effort to foster collaborative norms of interactions, leaving aside the idea of teacher isolation (Lieberman, 2000; Baumard & Starbuck, 2005; Collinson & Cook, 2004).

One of the most relevant concepts in teacher collaboration is the emergence of the professional learning communities (PLC). This concept could be defined as a community of educators who share and reflect critically on their practice in order to improve the learning of students and teachers. These collaborative professional interactions are often characterized by different elements such as shared values and vision, collaboration and trust (Bolam et al, 2005; Hord, 1997; Mitchell & Sackney, 2000; Verbiest & Vandenbergue, 2002; Louis & Marks, 1998).

On the other hand, there has been an increasing interest in better understanding social networks of pre-service teachers to enter the social systems of schools (Daly et al., 2010). A number of studies suggest the importance of professional and social relationships for pre-service teachers in achieving teaching and learning success (Bloomfield, 2010; Baldwin, Bedell, & Johnson, 1997; Hommes et al., 2012; Rizzuto, LeDoux, & Hatala, 2009) and commitment to the profession (Klasse, Peery & Frenzel, 2012). This collaborative perspective encourages a sense of community in which trusting relationships between and among pre-service teachers is generated and supported (Dinsmore & Wenger, 2006; Liou et al, 2014). Thus, peer social support could help manage individual pressures for new future teachers (Ewing & Manuel, 2005; Stauffer & Mason, 2013). In this sense, social interaction with peers has been considered as one of the critical factor for facilitating the learning process (Gasevic, Zouaq & Janzen, 2013). Hence, for the pre-service teacher's preparation it will be essential everything that helps to create a learning environment and a work exchange and experimentation, as well as a cooperative culture based on social and academic support and the opportunity to develop with more efficacy (Liou et al., 2016).

Method

Sample and Context

This project draws on survey methods in meeting its aims. A questionnaire was administered to a sample of 321 students enrolled full time either in Teacher Training Preschool Education Program (158 pre-service teachers) or Teacher Training Primary Education Program (163

pre-service teachers) at the Ramon Llull University-FPCEE Blanquerna in Barcelona, Spain. Of all participants, 277 were females and 44 were males. Pre-service teachers had a Grade Point Average (GPA) of 1.81 (ranged from 1 to 4), a Practicum Grade average of 7.97 (ranged from 1 to 10) and a Perception of Self-Efficacy of 6.68 (ranged from 1 to 9).

Before sending the questionnaire, students were informed about the object of the study, the process of the questionnaire administration as well as the benefits of the participation, including the return of the results and conclusions. In addition, at the beginning of the questionnaire students were asked about the confirmation of their voluntary participation in the research and their agreement about the prior information received about the project and the treatment of data. Each of the participants received an online survey during their 4th grade training program in October and November 2014 (6 weeks). We consider that the Practicum is the best theoretical and practical space to improve students' academic and professional skills in their last year in a real professional context. Thus, Practicum has an important role in the formative process as it complements the students' academic learning (theoretical and practical) with the experience (related to learning) in a workplace (Zabalza, 2006). The response rate of the questionnaire was about 80%.

Instruments and Data Collection

The questionnaire about social networks had been validated in previous studies (Liou et al., 2014), and was translated and adapted to our university context. The instrument consists of a variety of measures that have been collected in order to explore the professional competencies and development of each respondent, in terms of self-efficacy (12 items), satisfaction (21 items), individual trust (10 items), collective trust (21 items), individual innovation (10 items) and collective innovation (10 items). These scales focus on both individual and cohort perception around key construct in pre-service teachers development on a 9-point Likert-type agreement scale, ranging from 1 (totally disagree) to 9 (totally agree). The perception of self-efficacy was ranged from 1 (not at all) to 9 (totally).

Furthermore, it contains social network questions, where respondents had been provided a relational stem (collaboration, advice, new ideas, need to vent, friendship and influence) to which they named other cohort members to whom they turn for that relational resource and the frequency of that interaction. In the survey the students could choose from 1 to 4 depending on

the frequency of the interaction (with the anchors 1="once per month" and 4 ="once or twice per week"). They only have to choose those colleagues to whom they have some relationship, otherwhise they could leave the option blank. All these scales had been used previously in different studies, so it is a guarantee of validity and reliability.

The questions involve social and emotional support and task related support such as the case of advice "From whom do you seek advice regarding improving your practice". Respondents selected names from a complete roster of pre-service teachers' peers that was provided in order to reduce the measurement error and obtain more reliable results and a higher response rate. At the end, the questionnaire contains an open question if students wanted to add any comment or suggestion about the research. Moreover, we collected demographic variables about gender and group as well as students' outcomes using their GPA and Practicum grade when they finish their studies (June 2015).

Data Analysis and Measures

The data analysis follows a quantitative paradigm using a series of network statistics on the overall cohort. The network data had been entered and analyzed using UCINET 6 (Borgatti, Everett & Freeman, 2005), a software program that supports the static and dynamic analysis of network data. Also, we triangulate the study results through social network analysis by providing sociograms generated via NetDraw (Borgatti, 2002), a social network software that visualizes social network data. To test the hypotheses, we also conduct a series of correlation analysis and a multiple regression analysis to examine the relationship between social capital and pre-service teachers' achievement. Furthermore, we used the statistics program IBM SPSS Statistics for Windows, Version 21.0, as a support in our research.

For this study centrality measures of each participant were determined to analyze their social network position, as well as their social capital. Centrality captures the extent to which an actor occupies an important position in the social network, as a symbol of prestige and visibility (Carolan, 2014). So, being in a center position may offer individual potential in form of status, power and influence, increasing effect over the network because of access to multiple actors and the potential to create new linkages and the easier access to resource flows from the larger social network. Then, central actors have the possibility to guide, control, and broker the flow of resources within a group (Daly, 2012). On the other side, actors who are less central receive less

information and do not have the opportunities to gain from the resources and information as actors in more central positions (Daly & Finnigan, 2010).

In this research we used one of the most frequently centrality measures: Degree centrality and Betweenness centrality, that reflect the activity, control and efficiency of an actor in the network respectively (Freeman, 1979). All the centrality measures had been calculated on students and they had been normalized by the size of the network in order to be compared.

Degree centrality is the most frequently used centrality measure and it means the number of ties to and from and ego. Where *in-degree* is the number of ties received from others and *out-degree* is the number of ties sent to others (Carolan, 2014). Actors who have high out-degree centrality may be relatively able to exchange with others, or disperse information quickly to many others (actor seeker). So, they are often characterized as influential. Meanwhile, an actor with high in-degree centrality who receives many ties (actor giver) is characterized as prominent or popular. The basic idea is that many actors seek to direct ties to them, and so this may be regarded as a measure of importance. Normalized in-degree centrality is calculated as the number of incoming ties divided by the maximum number of ties in the network, while normalized out-degree centrality is calculated as the number of out-going ties divided by the maximum number of ties in the network (Carolan, 2014). The normalized scores are from 0 (an actor with no relationships with the others) to 1 (an actor is connected with all the others actors in the network).

Betweenness centrality measures the degree to which other actors lie on the shortest geodesic path between pairs of actors in the network. This measure captures how actors control or mediate the relations between pairs of actors that are not directly connected. So, the actors who are positioned "between" are considered to have more power and influence, controlling the resourced exchange within a network (Carolan, 2014). This measure normalized means the maximum possible betweenness position that an individual could probably reach in the network (Moolenaar et al., 2010). It was ranged from 0 to 1, depending on the possibility of reaching this position. Betweenness is also related to the key position of boundary spanners in brokering access to data. Therefore, social network theory suggests that actors or groups that diffuse resources between otherwise disconnected individuals (boundary spanners, brokers and bridges)

play an important role in the structure of a network, especially on the structural holes, as the result of weaker (or absent) connections between individuals (Daly, 2012; Burt, 2004).

Results

Results suggest that being central in networks (as an indicator of greater social capital) is positively related to academic and professional success. Especially, findings highlight the importance of the network advice and the position of broker, as it could be analyzed in the correlation and regression analysis.

Descriptive Statistics

Firstly, we calculated descriptive statistics for pre-service teachers' academic success (GPA) and professional competences (Practicum Grade and Perception of Self-Efficacy) as well as network characteristics (see table 1). Results suggest that, on average, pre-service teachers tend to ask for advice around 25% of their peers, the same as they tend to be asked for advice. For the network need to vent, on average, pre-service teachers out-degree and in-degree is around 9%, and for the ideas is around 14% of their network, also in both networks characteristics. So, the amount for the network characteristics in-degree and out-degree is similar in all the networks. On average, the betweenness characteristic is lower than in-degree and out-degree, around 1% in all the networks. Through these percentages we could see that instrumental network concerning advice is the most common relationship, following by the ideas network related to innovation. Therefore, the expressive network of need to vent seems to be the less frequent interaction for these pre-service teachers. Related to academic success, GPA is on average 1.81 (out of 4), and related to professional competences, Practicum Grade is on average around 8 (out of 10) and the Perception of Self-Efficacy is 6.68 (out of 9). So, on average, pre-service teachers' academic success and professional competences seem to be relatively high.

Avalaible in : *http://www.dau.url.edu*

Table 1. Descriptive Statistics

	M	**Min**	**Max**	**SD**
GPA	1.81	1.18	2.98	.33
Practicum Grade	7.97	4	10	1.21
Perception of Self-efficacy	6.68	3.75	9	1.08
Advice Out-Degree Centrality	.25	.00	1.03	.35
Advice In-Degree Centrality	.25	.09	.51	.09
Advice Betweenness Centrality	.01	.00	.10	.01
Need to vent Out-Degree Centrality	.09	.00	1	.23
Need to vent In-Degree Centrality	.09	.04	.21	.04
Need to vent Betweenness Centrality	.01	.00	.32	.02
Ideas Out-Degree Centrality	.14	.00	1	.27
Ideas In-Degree Centrality	.14	.06	.34	.07
Ideas Betweenness Centrality	.01	.00	.15	.02

Correlation Analysis

A Pearson's correlation analysis was made in order to examine the relationship between pre-service teachers' social networks and students' academic and professional performance (see table 2 - table 4).

The correlation analysis provides the findings suggesting that there was a positive correlation among all the network characteristics in almost all the networks, which seems coherent given the way that these measures were calculated, because all these centrality measures reflect the same idea of being in an important and central position in the network, although they are measured in different ways. In both degree and betweennes centrality, a high value means a high centrality position. In this case, the number of ties an actor gives or receives as a measure of connectedness is also related to students' between connectedness networks.

In terms of grades, we found a positive correlation between pre-service teachers' GPA and Practicum Grade (r=.616, p<.01) suggesting that students with high (or low) scores in their GPAs they also tend to have high (or low) scores in their Practicum Grades. Therefore, the pre-service teachers' success, reflected with high scores, seems to be related in both academic and professional sense.

Table 2. Correlation Analysis

Advice	1b	1c	2a	3a	3b
1. Network characteristics					
a. In-degree centrality	.301**	.212**	.153*	.069	.020
b. Out-degree centrality	--	.685**	.100	.044	.086
c. Betweenness centrality		--	.172**	.062	.138*
2. Academic success					
a. GPA			--	.616**	.001
3. Professional competences					
a. Practicum Grade				--	.082
b. Students' Perception of Self-Efficacy					--

Note. **p<.01, *p<.05

Table 3. Correlation Analysis

Need to vent	1b	1c	2a	3a	3b
1. Network characteristics					
a. In-degree centrality	.143*	.383**	.130*	.075	-.017
b. Out-degree centrality	--	.522**	.078	.026	-.012
c. Betweenness centrality		--	.078	.162**	.005
2. Academic success					
a. GPA			--	.616**	.001
3. Professional competences					
a. Practicum Grade				--	.082
b. Students' Perception of Self-Efficacy					--

Note. **p<.01, *p<.05

Table 4. Correlation Analysis

New Ideas	1b	1c	2a	3a	3b
1. Network characteristics					
a. In-degree centrality	.234**	.366**	.240**	.099	.093
b. Out-degree centrality	--	.633**	.042	.013	.055
c. Betweenness centrality		--	.141*	.097	.013
2. Academic success					
a. GPA			--	.616**	.001
3. Professional competences					
a. Practicum Grade				--	.082
b. Students' Perception of Self-Efficacy					--

Note. **p<.01, *p<.05

Then, we explored the suggested positive relationship between a more connected network in a centrality position and a great academic performance. Focusing the attention on network properties and GPA, we detected that students' academic success was related to in-degree in all the networks (advice: r=.153, p<.05; need to vent: r=.130, p<.05; new ideas: r=.240, p<.01) and betweenness in advice (r=.172, p<.01) and new ideas (r=.141, p<.05) networks.

This could mean that, in terms of degree, actor givers who are considered more prominent or popular are the ones who have a better academic performance. Therefore, when an actor receives more ties in academically terms, the greater is his performance.

Results also suggest a correlation with betweenness indicator and GPAs. So, we found that being in a betweenness position as a broker is important for the intangible educational and emotional flow, controlling the information in order to have more success. This correlation analysis provides some first insights in the relationships between students' social networks and GPAs in a positive way, meaning a correlation between social capital, in terms of in-degree and betweenness, and academic performance in all the networks.

Concerned with professional success, findings suggest a positive correlation between pre-service teachers' position centrality, in terms of betweeness, and their Practicum Grades and Perception of Self-Efficacy. Specifically, we found a positive relationship with betwenness indicator and Practicum Grade in the need to vent network (r=.162, p<.01). The same happened for students' Perception of Self-Efficacy with a positive correlation among betweenness in ask for advice network (r=.138, p<.05).

Therefore, this betweenness measure has a positive correlation with students' professional performance, which indicates that when students mediate the relations between pairs of actors that are not directly connected to others, they tend to have more professional success. Concretely, being a broker in the instrumental network of advice is related to a more Perception of Self-Efficacy, while being in a betweenness position in the expressive network need to vent is more related to a better Practicum Grade.

Regression Analysis

In order to find the causality effect of the variables, we did a multiple regression analysis. For the academic success in the regression analysis, we selected the indicators of centrality that had more correlation with this variable. Then, we chose in-degree and betweenness for each network

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in order to determine the regression with GPA. On the other hand, for professional success we chose the betweennes indicator in order to explore if exists causality between this position and the professional performance for each network. Findings suggest that there were positive relationships (see table 5). The proportion explained variance for each of the tested model is small (R^2 and R^2 adjusted from 0.014 to 0.058), meaning that only a small part of the variance could be explained with the social network characteristic under study.

Table 5. Multiple Regression Analysis

| Network characteristics	GPA			Practicum Grade			Perception of Self-Efficacy		
	β	Adj R2	R2	β	Adj R2	R2	β	Adj R2	R2
Advice In-degree	-.145			-			-		
New ideas In-degree	**.240***			-			-		
Need to vent In-degree	-.179			-			-		
		.054	.058		-	-		-	-
Advice Betweenness	**.172***			.017			**.138***		
New ideas Betweenness	.065			-.009			-.051		
Need to vent Betweenness	.032			**.162***			-.036		
		.026	.030		.023	.026		.014	.019

Note. **p<.01, *p<.05

Concerned with GPAs, in-degree indicator in the new ideas network is related to a positive effect on students' academic performance (r= .240, p< .05). In terms of betweenness, the advice networks is related to a positive effect on GPAs (r= .172, p< .01). Therefore, new ideas and advice networks have an influence on students' academic success. Results replicated our correlational analysis, suggesting that GPAs are generally positively related to the advice network in betweenness position and also with ideas network in in-degree position.

Results can also be presented graphically through the network sociograms that provide initial visualization of the network structure generated by NetDraw (Borgatti, 2002). Figures 1 and 2 represent the pre-service teachers' new ideas and advice networks in a group of pre-service teachers. Students are represented by squares (nodes) and lines that connect these squares illustrate pre-service teachers' new ideas and advice ties. Nodes are colored by the GPA, ranging from 1 to 4. The light shade of blue indicate a GPA between 1-1.9 and the dark shade of blue indicate a GPA ranging from 2-3.9. Grey represents those pre-service teachers that don't have a

GPA yet. Then, we sized individuals by centrality measures by the numbers of incoming ties (in-degree) in new ideas and "in betweenness" (betweenness) in advice. Bigger nodes reflect more in-coming and betweennes ties in each case. These sociograms correspond to our regression analysis, showing that in general bigger nodes represent also higher grades (dark shade of blue).
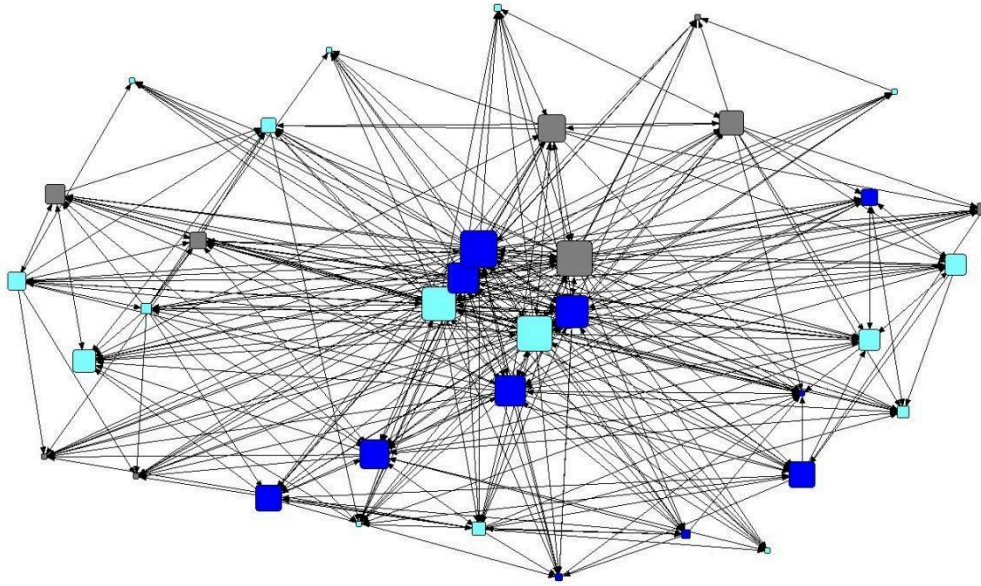
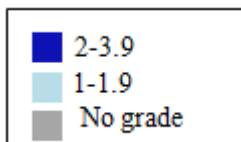*Figure 1. Example of pre-service teachers' GPA in a new ideas network (in-degree)*

GPA

■ (dark blue)	2-3.9
■ (light blue)	1-1.9
■ (grey)	No grade
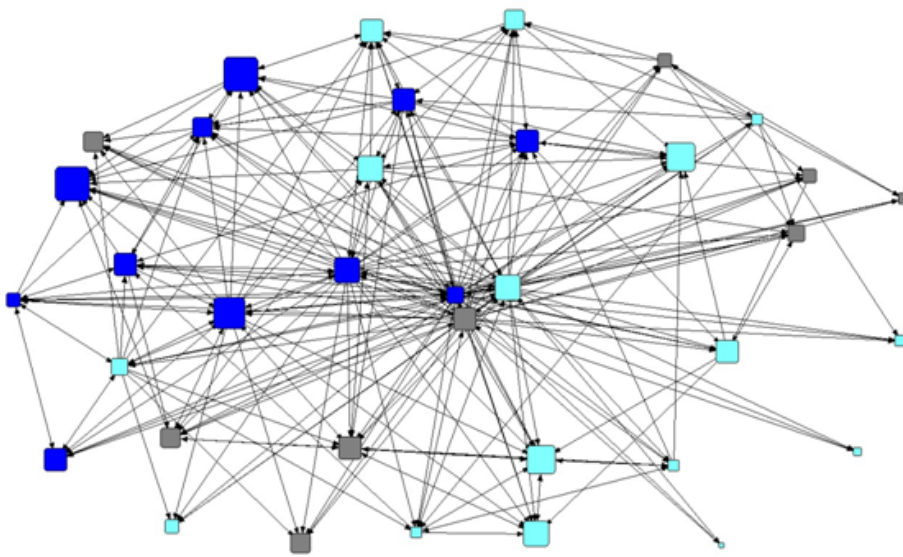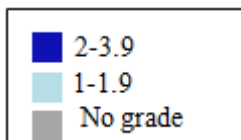
Figure 2. Example of pre-service teachers' GPA in an advice network (betweenness)

GPA

As it happens with GPAs, advice network has a positive effect on professional success in terms of students' Perception of Self-Efficacy with the betweenness indicator (r= .138, p< .05). At the same time, the students' professional performance considering Practicum Grade was found to be effected by the need to vent network with the network characteristic of betweenness (r= .162, p< .01).

Figure 3 represent graphically the pre-service teachers' Perception of Self-Efficacy sense of efficacy, ranging from 1 to 9, also in the advice network. For this case, the light shade of blue indicates a sense of self-efficacy between 1-4.9, the dark shade of blue between 5-6.9, the purple between 7-8.9 and green 9 (just one pre-service teacher). Then, according to our regression results we sized individuals by the position "in betweennness" and we could contrast our results by sociograms, because the most central actors are the ones represented with purple. Grey represents the non-response.

Figure 3. Example of pre-service teachers' Perception of Self-Efficacy in an advice network (betweenness)

Avalaible in : *http://www.dau.url.edu*
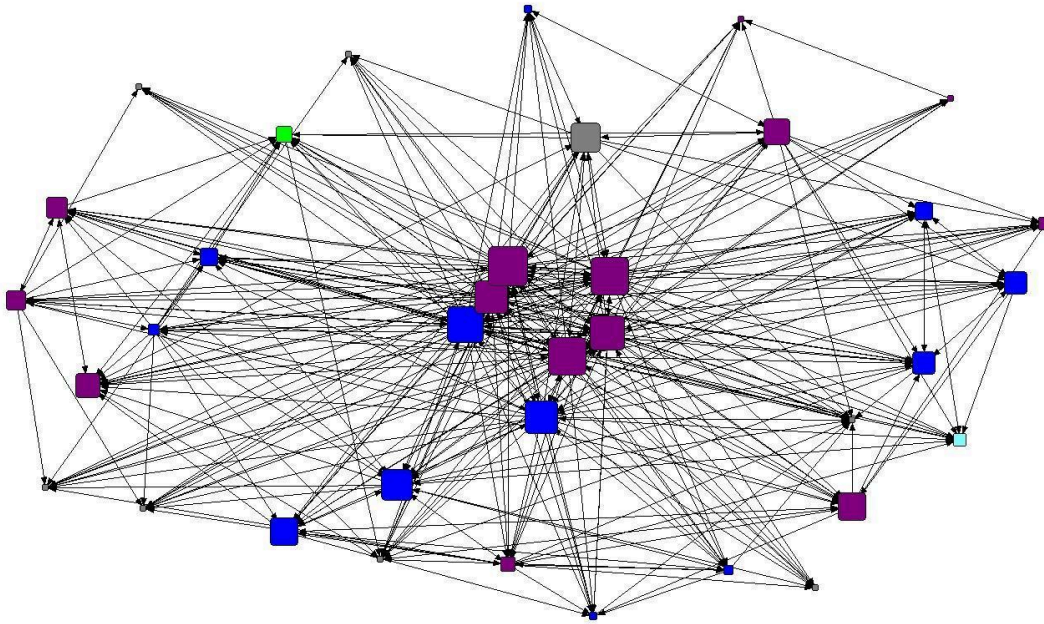

Perception of Self-Efficacy
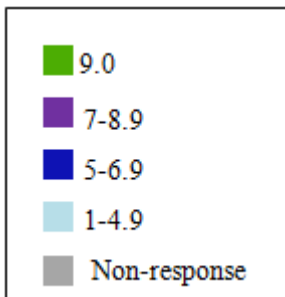
On the other hand, figure 4 represent the pre-service teachers' need to vent network sized by the position "in betweenness" regarding their Practicum Grade, ranging from 1 to 10. In this sociogram, the light shade of blue indicate a sense of self-efficacy between 6-6.9, the dark shade of blue between 7-7.9, purple between 8-8.9 and green between 9-9.9. In general, the green nodes are the bigger ones, according with our analysis.

Figure 4. Example of pre-service teachers' Practicum Grade in a need to vent network (betweenness)

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Practicum Grade

■	9-9.9
■	8-8.9
■	7-7.9
■	6-6.9
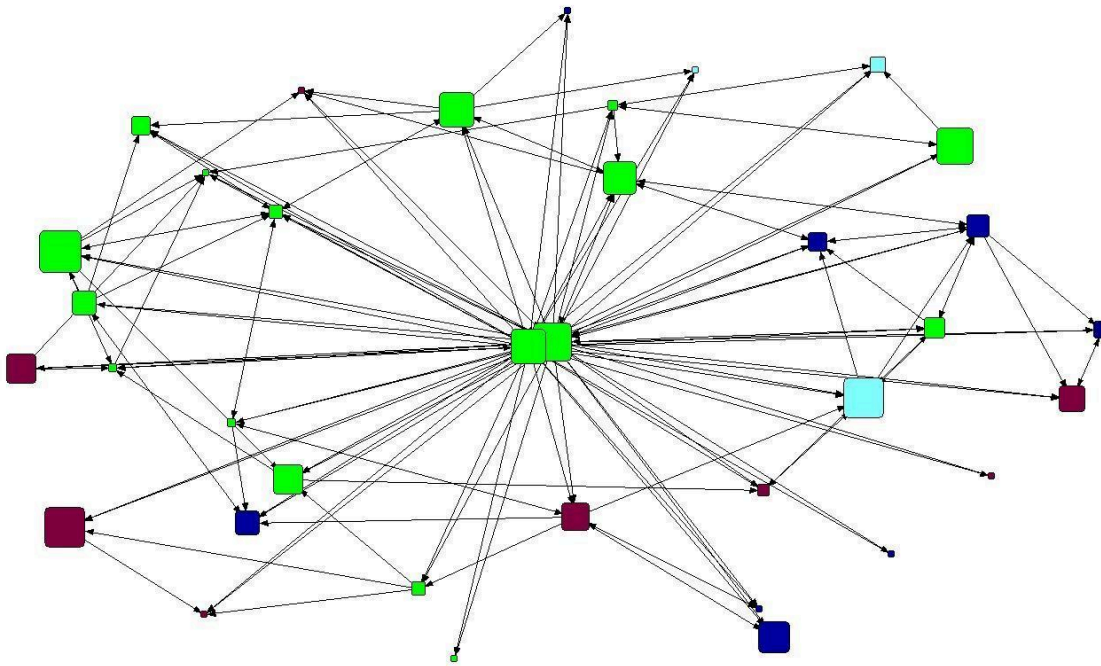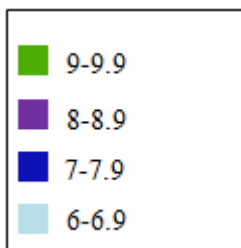
Discussion and conclusions

Results build on previous network studies in education in general and further extent this important social aspect to the field of teacher education. Moreover, this work has implication on how teacher educators create social and cognitive conditions for pre-service teachers' development that have the potential to support the preparation of successful pre-service teachers (Liou et al., 2016). Therefore, our findings highlight the importance of pre-service teachers' social side and their cognitive conditions in supplementing the individual and instructional knowledge and skills. In this sense, we foreground the importance of social capital in pre-service teacher to support initiatives of policy implementation attending the role of social ties.

Through results we found that network centrality may be a predictor of teachers' academic success. Several studies highlight the positive association between social ties and academic

performance (Baldwin, Bedell, & Johnson, 1997; Cho, Gay, Davidson, & Ingraffea, 2007; Hommes et al., 2012; Mayer & Puller, 2008; Rizzuto, LeDoux, & Hatala, 2009; Smith & Peterson, 2007; Thomas, 2000; Yang & Tang, 2003; Yuan, Gay & Hembrooke, 2006).

In our results, the more a pre-service teacher is selected to share for new ideas, the more is his/her academic success reflected by the GPA, meaning that he/she is "popular" in the new ideas network, because it shows that he/she is able to provide and share new information to their team members that could help to innovate. Therefore, results suggest the importance of being a new ideas giver. This means that pre-service teachers have a positive attitude towards development and trying new ideas and this could imply the creation of an innovative climate (Moolenaar et al., 2010). Innovation has been understood as the development and use of new ideas, behavior and practices (Daft & Becker, 1978; Damanpour & Evan, 1984). Therefore, the combination of different people, knowledge and resources is needed for sharing new ideas and practices, highlighting the social process toward an innovative climate (Kogut & Zander, 1992; Paavola, Lipponen, & Hakkarainen, 2004). In an educational context, an innovative climate is defined as educators' shared perceptions involving practices, procedures, and behaviors that promote the generation of new knowledge and practices (Van der Vegt, Van de Vliert & Huang, 2005).

Moreover, the diffusion of ideas is related to the concept of weak ties (Granovetter, 1982) and it exists a relation between weak ties and network centrality (Sparrowe, Liden, Wayne & Kraimer, 2001). Furthermore, the importance of degree centrality in academic performance has been demonstrated in different studies (Smith & Peterson, 2007; Baldwin et al., 1997; Gasevic et al., 2013). Nevertheless, no significant relation was found between outgoing and betweenness relationships and academic success. In contrast, academic success seems to be related in a network as a sought of ideas.

Results also showed that being an advice "in between" is related to more academic (GPAs) and professional success (Perception of Self-Efficacy). So, occupying a betweenness position may offer the potential to bridge the gap between otherwise disconnected actors within a network, controlling the flow of information that may support the generation of new knowledge and practices (Moolenaar et al., 2010) that may contribute to pre-service teachers' performance. Additionally, the brokerage position is related to actors who bridge structural holes in a network (Burt, 2005), so they could control information flow and are positively associated with benefits (Gasevic et al, 2013). Also, brokerage position produce more innovative results (Burt, 2004) so,

the brokerage position in advice network could imply these innovative actions for improving the academic performance as well as their self-perception of efficacy, as efficacy is likely to grow if preservice teachers innovate and take risks (Tschannen-Moran, 2014).

Self-efficacy refers to one's beliefs to successfully take actions in order to accomplish certain tasks or achieve some specific goal (Bandura, 1993). Therefore, our study suggest that occupying this go-between position is related to a more Perception of Self-Efficacy, because of the potential of control that this actor may have in the instrumental advice network that helps to being more confident in his ability to teach. Additionally, a stronger sense of efficacy has multiple benefits such as a greater teacher motivation and greater student achievement (Tschannen-Moran & Hoy, 2007).

In line with our results, several studies show that performance indicators are positively associated with weak ties and advice networks (Granovetter, 1973; Levin & Cross, 2004; Nahapiet & Ghoshal, 1998; Sparrowe et al., 2001). Moreover, this study supports earlier work that suggested a relationship between teachers' social networks and teachers' self-efficacy (Liou et al., 2014).

Finally, results also suggest that being "in between" in an expressive network of emotional support is positively associated with better professional success in terms of their Practicum program. This program is a space where students need a strong emotional support from their peers for developing their performance as a teacher in a classroom. For career teachers, if they received higher sources of support from their colleagues, parents and community, they tend to hence their satisfaction and their professional performance (Tschannen-Moran & Woolfolk Hoy, 2001). For this reason, those actors who occupies a betweenness position in the need to vent network could control the support ties and get a better grade related to their performance. Therefore, results highlight the importance of being in a brokerage position in a network.

To sum up, results show that program reform should look at socio-emotional skills, collaborative and innovative learning climates and more social capital comprehensiveness. In this sense, university programs must consider to strengthen students' formal and informal interaction within the program, across programs, with school teachers and also with other educational entities, in order to set the scenario where students need to build trusted relationships that support their practice in a constructive community.

Additionally, our findings shed some light on emerging teaching models that are based on team teaching, co-teaching, collaborative teaching or educational collaborative networks as models where more knowledge is shared and built. Program reform could address to increase social capital also by promoting a collaborative environment, based on trust, so as an orientation to innovation from a practical standpoint. In line with our results, social capital could play an important role being a mediator effect between a collaborative innovation climate and teachers' performance.

Another practical implication within the program reform is the emergence of the use of new methodologies for problem solving with the support of cooperative teamwork, such as design thinking, a method for solving problems with creative solutions through a process of cognitive activities, and problem based learning, based on learning from the experience of solving a real problem while developing different skills such as leadership,creativity and teamworking.

Focusing on teachers' skills, beyond resources, methodology and school management, relational competencies to increase social capital need to be implemented also in teacher training programs in order to adapt to our current socioeducational challenges and improve the educational system. Better understanding the role of social networks in knowledge generation and resources exchange between pre-service teachers is widely important given the need of advancing in teacher collaboration in interdisciplinary educational communities. For this reason, it should be highlighted the awareness of students' personal networks, known as ego networks, emphasizing the importance of personal relations and individual social structures as a source of resources, adopting an egocentric analysis in a social network perspective.

Limitations and future research

There are several limitations of this study that should be mentioned and provide useful directions for further studies. First, by focusing only on the social capital between the students in the university we could miss information of their other social networks. This project doesn't take into account the possible direct and informal relationships of pre-service teachers with their immediate environment, such as families and friends, so it could be interesting focus also both on internal and external networks. Nevertheless, this approach has enabled us controlling the relation within the program.

Second, in our study we have focused on centrality measures based on degree and betweenness. Otherwise, in future studies it would be helpful to investigate other relevant centrality measures such as closeness centrality to explore whether this measure has also an influence in pre-service teacher's success. This centrality measure captures the average distance an actor is from all other actors in the network depending on the length of shortest path connecting a pair of actors. Therefore, closeness centrality is an indicator of how quickly an actor can exchange something with others, as being "close" to others may provide an advantage for sharing resources (Carolan, 2014). This closeness measure could be also divided into incloseness, proportion of number of shortest distance required for other actors in a network to access an actor, and outcloseness, the number of shortest distance required for an actor to access other actors in a network (Liou et al., 2016).

Additionally, for future studies is relevant to use more mixed methods in order to triangulate our results with the use of qualitative data such as interviews or observations, and it would also be interesting to study the ego networks, so that we can approach to a broader spectrum of the students' social capital beyond class interactions.

Furthermore, a future study could explore the development and network trajectories of pre-service teachers, doing a longitudinal analysis and also analyzing how social networks of pre-service teachers evolve over time, and may explore the relation between our key variables in another network, such as friendship or influence.

At the same time, the study focuses on a specific context with students enrolled at Ramon Llull University-FPCEE Blanquerna in Barcelona but it could be interesting to transfer to other contexts considering the relevant adaptations.

In sum, with this study we want to highlight the importance in education of pre-service teachers' social capital, particularly focusing on their initial training and their academic and professional success. Finally, our proposal is to encourage other future research deepening the study of social network analysis as well as the measurement of social capital in improving educational practice.

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