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Professional learning communities in initial teacher education in Uruguay: social network analysis

Comunidades profesionales de aprendizaje en la formación inicial del profesorado en Uruguay: análisis de redes sociales

Comunidades de aprendizagem profissional na formação inicial de professores no Uruguai: análise de redes sociais

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Abstract

This research addresses a network analysis in three teacher education centers for teachers and professors in Uruguay to determine the degree to which they function in professional communities according to four aspects: innovation initiatives, information exchange, digital inclusion, and collaboration in planning. The study is based on a previous categorization regarding the level of digital inclusion for deep learning on the basis of an online survey applied to 32 principals of public teacher education centers (high, medium, and low levels). One case was identified at each level, taking into account the geographic characteristics and the type of teacher education center. In each case, information-gathering techniques were applied: in-depth interviews, surveys for the network analysis, and focus groups. Results show that in all three cases, professional learning communities lite (as defined by Dufour & Reeves, 2016). In two of the centers, those with the higher rate of digital inclusion for learning, there is a diversity in the actors who form the ties that make up the networks. Last, the innovation network is the weakest in terms of the number and variety of the ties.

Resumen

Esta investigación aborda el análisis de redes sociales en tres centros de formación inicial de maestros y profesores en Uruguay, para determinar el grado en que alcanzan un funcionamiento en comunidades profesionales de aprendizaje, en función de cuatro aspectos: iniciativas de innovación, intercambio de información, inclusión digital y colaboración en la planificación. El estudio parte de una categorización previa respecto al nivel de inclusión digital para el aprendizaje profundo, a partir de una encuesta online a los 32 directivos de centros públicos de formación docente inicial (nivel alto, medio y bajo). Se identificó un caso para cada nivel teniendo en cuenta características geográficas y modalidad de formación docente. En cada caso, se aplicaron técnicas de relevamiento de información: entrevistas en profundidad, encuestas para el análisis de redes y focus group. Los resultados permiten afirmar que en los tres centros existe una conformación de comunidades profesionales de aprendizaje ligeras. En dos de los centros, los que poseen un mayor índice de inclusión digital para el aprendizaje, existe diversidad de actores como base de los vínculos que integran las redes. Por último, la innovación es la red más débil en cuanto a cantidad y variedad de vínculos.

Keywords:

communities of practice, professional development, preservice teacher education, teacher collaboration, network analysis.

Palabras clave:

comunidades de práctica, desarrollo profesional, formación inicial docente, colaboración docente, análisis de redes.

Resumo

Esta pesquisa aborda a análise das redes sociais em três centros de formação inicial de professores do ensino fundamental y do ensino medio no Uruguai, para determinar o grau em que eles conseguem um funcionamento em comunidades de aprendizagem profissional com base em quatro aspectos: iniciativas de inovação, troca de informações, inclusão digital e colaboração em planejamento. O estudo parte de uma categorização prévia quanto ao nível de inclusão digital para deep learning, a partir de uma pesquisa online com 32 gestores de centros públicos de formação inicial de professores (nível alto, médio e baixo). Foi identificado um caso para cada nível tendo em conta as características geográficas e a modalidade de formação dos professores. Em cada caso, foram aplicadas técnicas de coleta de informações: entrevistas em profundidade, pesquisas para análise de rede e grupos focais. Os resultados permitem afirmar que nos três centros há formação de comunidades leves de aprendizagem profissional. Em dois dos polos, aqueles com maior índice de inclusão digital para aprendizagem, há uma diversidade de atores como base dos vínculos que compõem as redes. Finalmente, a inovação é a rede mais fraca em termos de quantidade e variedade de links.

Palavras-chave:

comunidades de prática, desenvolvimento profissional, formação inicial de professores, colaboração do professor, análise de rede.

Introduction

This article addresses the creation of professional learning communities as a form of interrelation among teachers, generating diverse results that impact student learning (Krichesky & Murillo, 2011). Previous studies on this topic have been carried out in educational systems of different countries (amongst the most recent ones: Brown *et al.*, 2018; Feldman, 2020; Hairon *et al.*, 2019; Prenger *et al.*, 2018; Rigney *et al.*, 2021). Even though some of these investigations focus on different aspects of professional learning communities, generally, they agree in highlighting that this level of organization among teachers favors professional development based on critical reflection and evidence-based practices, increases teachers' well-being, and improves motivation for work (Antinluoma, 2018; Cholifah & Oktaviani, 2019; Donoso, 2020; Vaillant, 2019). On the other hand, the constitution of these communities influences how organizational knowledge is created and developed (Rodríguez-Gómez, 2015). Other studies on professional learning communities in educational centers with different characteristics and levels have emphasized aspects such as the professional skills of teachers and the organizational climate, pointing them out as critical components for the constitution of communities (D'Ardenne *et al.*, 2013; Dogan *et al.*, 2015; Ning *et al.*, 2015; Owen, 2014).

Even though academics agree in highlighting some results and components of this way of organization amongst teachers, the concept of professional learning communities is multifaceted. It can refer to a small team of teachers that collaborate to produce learning among colleagues within the organization (Owen, 2014), or, to the extent collaboration goes beyond the different groups, it transforms into a work culture that involves the whole educational center (Vangrieken *et al.*, 2015).

In keeping with previous studies and regarding the development of professional learning communities (Lizcano & Hennig, 2022), it is fundamental to understand teachers' relationships, that is, to diagnose interactions that happen within the organization to visualize to what extent groups are transformed into collaborative teams (De Dios, 2020). To achieve this insight, network analysis proves to be an ideal tool. The works of Scott (1990), Wasserman & Faust (1994), and Carrington *et al.* (2005) delve into the methodology of this analysis, initially used in the field of sociology, while Morales (2011), Baker-Doyle (2014), Carolan (2014) and Froehlich *et al.* (2020) raise the relevance of its use in the educational field.

In any case, social network analysis at the educational institution level makes the interactions based on collaboration among teachers visible, allowing one to focus on the role that ties play at the individual, group, and organizational levels (Hargreaves & O'Connor, 2018).

The characteristics of the interactions among educators influence the individual, social, and professional capital and result in the constitution of professional learning communities (Hargreaves & Fullan, 2012; Questa-Tortero, 2018).

The impact of interrelations in different aspects of professional activity, such as pedagogical innovation and improvement of student learning, will partially depend on whether the type of tie developed within the networks is strong or weak (Quinn & Kim, 2018; Spillane *et al.*, 2014). Likewise, the type of tie generated influences the characteristics of the community formed by the teachers. Groups of teachers can achieve professional learning communities or remain in stages that imply lower

levels of professional involvement. These stages, systematized by Vangrieken et al. (2015), usually imply weaker or less interactions, with less incidence of collaboration for collective learning, fewer opportunities for joint reflection, and scarce knowledge management initiatives (Questa-Tortero, 2018). Implementing a professional learning community can also remain in the teachers' collective imagination, at the discourse level, or in superficial changes in the working practices. When this happens, Dufour & Reeves (2016) call this stage a professional learning community lite.

When communities work towards collaboration and learning, social relations among teachers arise, identified by Carolan (2014) and Sun *et al.* (2014) as facilitators of access to information, change in pedagogical practices, and innovation. In the context of this research, innovation is understood as the implementation of new or improved ideas, knowledge, or pedagogical practices in education, either at the level of teaching processes or at the level of the educational organization (Organisation for Economic Cooperation and Development [OECD], 2016).

As a consequence of the operation of the teachers' networks formed by individuals oriented toward formal professional development, work synergies facilitate innovation and can influence both interactions within the organization as well as their results (Hopkins *et al.*, 2013; Penuel *et al.*, 2012). In these scenarios, the inclusion of technologies provides a differentiator for the professional learning communities, facilitating relationships among colleagues, favoring knowledge creation, ensuring its dissemination, and strengthening professional learning. Therefore, teams of teachers taking advantage of technology to favor collaborative work and peer-to-peer interrelations results in the improvement of the professional capital of the organization (Hargreaves & Fullan, 2012).

As López *et al.* (2018) described, social network analysis has been used in different educational research contexts, such as higher education and pedagogical leadership. It has also been used at the primary educational level, delving into different aspects of the impact of network collaboration (Garay *et al.*, 2019; Sannen *et al.*, 2021). For instance, a recent study in schools by Sinnema *et al.* (2020) uses social network analysis to explore communities of practice based on three key concepts: leadership, experience, and networks articulated by collaboration and advice.

According to the focus of this research, the previous studies from Van Waes *et al.* (2017) on teachers' networks in higher education are relevant. On the other hand, little is delved into the teachers in the teacher education program. However, as a mirror to collaboration among teachers and the measuring of its impact, the works of Civis *et al.* (2017), Gómez *et al.* (2015), Liou *et al.* (2016), and Tomàs *et al.* (2016) are key. These studies incorporate network analysis from the student teachers' perspective. However, despite the increase in the last decades in the number of investigations that relate digital technologies with norms of social behavior that foster communities (Antoci *et al.*, 2012; Bauernschuster *et al.*, 2012; Burke *et al.*, 2011; Camacho *et al.*, 2020; Ellison *et al.*, 2007), studies that use social network analysis among teacher trainers to make the impact of these interactions visible in aspects such as innovation or digital inclusion with pedagogical aims are still scarce.

In this study, we propose to use social network analysis of teachers in three teacher education centers for teachers and professors in Uruguay to determine the articulation of the ties in four aspects: innovation initiatives, information exchange, digital inclusion, and collaboration in planning, and to determine to which extent a professional learning

community has been achieved in each case. In this context, it should be noted that despite the universal access to digital resources in education—particularly in teacher education—achieved by Plan Ceibal in Uruguay (Fundación Ceibal, 2020), different studies show that digital inclusion is scarce for the development of teachers' digital skills, while the use and impact of educational technologies in teaching is not made visible in the students' learnings (Cabrera Borges *et al.*, 2018; Morales *et al.*, 2020; Silva *et al.*, 2018, 2019).

Therefore, this study is justified by the need to strengthen Teacher Education Institutions to improve education and the relevant role that digital tools and platforms may have in the constitution of professional learning communities. Among the diagnostic options is the teachers' networks analysis that supports collaborative processes.

The article reports part of the results of a larger study with several stages in which teacher training centers in Uruguay and Chile participated. For this contribution, based on identifying and characterizing public educational institutions for teacher training in Uruguay, we sought to identify, characterize, and represent the different types of interactions that occur in the context of teacher training communities. These results arise from analyzing social networks between actors of the selected centers.

Methodology and development

This study had a previous quantitative data collection stage in 2019 when a self-administrated online questionnaire (Redes e Inclusión Digital, 2019) was sent to 32 principals of public educational centers of teacher education in Uruguay, and 27 answers were received. Based on the data collected, three indexes were created to measure the dimensions of the questionnaire according to the technology usage level (high, medium, low), achievement of deep learning, the constitution of professional learning communities, and a fourth general index. The latter allowed to compare centers to select three cases based on how much they incorporate the dimensions mentioned above in their teaching practices.

Based on the questionnaire, the quantitative stage constituted the basis for selecting the centers. However, representing geographically different areas of the country was also considered when choosing the case studies and avoiding location proximity among them. Once the cases were selected, in-depth interviews were conducted with key stakeholders, including informants in each center's managerial roles, teaching roles, and experts in educational technologies. The interviews sought to delve into the following dimensions of analysis: general assessment of the incorporation of ICTs into teacher education, professional learning communities, strengths and weaknesses of incorporating digital technologies for deep learning, and innovative activities. Fifteen interviews were conducted, which were mediated by video conferencing tools in the face of the COVID-19 emergency in 2020.

Then, an online survey (Redes e Inclusión Digital, 2020) was applied for the social network analysis in each of the selected centers. The main dimensions considered were the ties related to the exchange of information, teacher planning, pedagogical innovation, and activities outside the workplace. In this sense, relevant measures were taken regarding density -the proportion between possible contacts and declared contacts- and centrality -the higher number of relationships that nodes concentrate-

(del Fresno García *et al.*, 2016). The instrument was sent to all the teachers of the selected centers, from which 73 responses were obtained. Data were processed with Visone (to represent the networks in graphs) and Ucinet software (to carry out the analysis of networks properly), which facilitated the creation of graphs of the existing social networks in each center.

Finally, a focus group in each teacher education center was conducted, with a total of 19 participants. The script for the focus group incorporated the following topics: digital technologies, professional learning communities, and innovation. This technique was also conducted via video conferencing due to the suspension of in-person instruction in all educational centers and the health protocols in force in the country. The transcription of the interviews and focus groups were processed in Atlas.ti, considering the dimensions mentioned above. The strategy for data analysis presented proposes the comparison of the three chosen cases. Table 1 shows the code and techniques for each case, according to the involved stakeholders.

Table 1
Coding of cases, techniques, and participants

Cases	
Assigned Name	Coding of case
Case 1 (High index)	C1
Case 2 (Medium index)	C2
Case 3 (Low index)	C3
Techniques	
Type	Coding of techniques
Interviews	E
Focus groups	FG
Participants	
Role	Coding of role
Director	D
Technology guidance teacher	T
Student	E
Another role	O

The results presented in this article focus fundamentally on the network analysis obtained from processing the data that emerges from the questionnaire applied in each of the three selected cases in Uruguay (Redes e Inclusión Digital, 2020).

Results and Discussion

In this section, as was mentioned, the focus of the presentation will involve aspects related to social network analysis, considering the objective of the article: identify, characterize, and represent the different types of interactions that occur in the context of teacher training communities (Sannen *et al.*, 2021). Therefore, the information is organized from the broad characteristics of the considered networks to the particularities in each case and each type of interaction.

General characteristics of the networks in each of the three cases studied

One often identified aspect is that half of the contacts occur internally in the academic department's context (Consejo de Formación en Educación [CFE], 2008). One plausible interpretation is that, even though academic departments are a strong nucleator of ties in the studied centers, they are not the only context in which they happen; a substantial proportion of contacts occur among actors from different departments. It should be noted that in the teacher education centers in Uruguay, the teachers are the only actors that belong to (only) one department.

Another confirmed aspect was the stability of the center's academic staff. When considering this variable, it is assumed that the longer they have been working in the center, the higher the number of ties. In this regard, it is verified that Case 1 has a more stable academic staff than the others because the higher percentages are in the most senior groups (Table 2).

Table 2
Percentage of ties according to the seniority of the respondents

	Case 1	Case 2	Case 3
Less than 1 year	9,2	38,2	36,4
Between 1 and 2 years	9,0	26,5	0
Between 3 and 5 years	48,2	11,8	27,3
More than 6 years	33,6	23,5	36,4

Note. Case 1 shows a greater degree of permanence of teachers in the institution compared to Case 2 and Case 3, as indicated in shaded.

Closely related to the above, it is interesting to know among which stakeholders the ties happen. In order to do that, it is helpful to analyze the percentage of ties identified for each sector: Teachers, Principals, Technological Guidance Teachers (DOT as per its Spanish acronym), administrative staff, or others (Table 3).

Table 3*Percentage of ties according to the position*

	Case 1 (n=73)	Case 2 (n=34)	Case 3 (n=52)
Teachers	59,8	62,6	58,7
Principals	8,4	12,6	6,5
DOT	6,19	7,6	7,5
Administrative staff	21,5	12,48	16,3
Others	4,12	4,8	11,9

From the analysis of Table 2, it can be said that teachers are those who show a higher percentage of ties at the institutional level and that there are no significant differences in this regard among the centers. These data are relevant if one considers what Carlona (2014) and Sun *et al.* (2014) mention; the authors state that ties among teachers favor access to information and innovation. In addition, ties also influence the individual, social, and professional capital of those involved (Hargreaves & Fullan, 2012).

A fact that deserves reflection is the percentage of ties attributed to the DOT; though not high, they are relevant stakeholders in managing digital technologies in the center. It is worth highlighting that this role is filled by at most three people in each institution (in the cases studied, the number ranges between one and three). The relevance of the DOT as a key stakeholder that supports other teachers in the process of incorporating digital technologies in the classroom emerges from the interviews with the principals of every center:

"DOTs are indirect teaching positions; they stay longer in the institution. There is more time for anything related to being able to think, plan that disposition, and say, 'OK, I am going to go to my colleague's classroom because I have this schedule that allows me to join their class or to join the schedule of the office hours'." (C2ED)

"...we put together our shifts and ensure that there is never a lack of a guidance teacher, who has the opportunity to be in more than one shift, (...), the DOT, who one goes in one shift, and another goes in a different one, and teachers can count [on them]." (C1ED)

"That you can count on the support of the DOT, who are those who know the devices the most, and in turn, also strengthen the ties and from there, that ties remain established, which may allow, let's say, obviously, that tomorrow these things continue and grow." (C3ED)

On the other hand, the number of ties between principals, administrative staff, and other stakeholders shows that these are centers where the networks involve actors from every level and are not restricted only to teachers. This fact becomes relevant if one considers what Vangrieken *et al.* (2015) state with regard to how collaboration goes beyond different groups, which would evidence that there is a sign of work culture at the center level.

From the network analysis, it is concluded that in the three cases, a clear decrease in the network's density can be noted when one moves from the Information network to the Planning network and finally to the Innovation one. Table 4 shows how this is a recurrent phenomenon in all three cases studied.

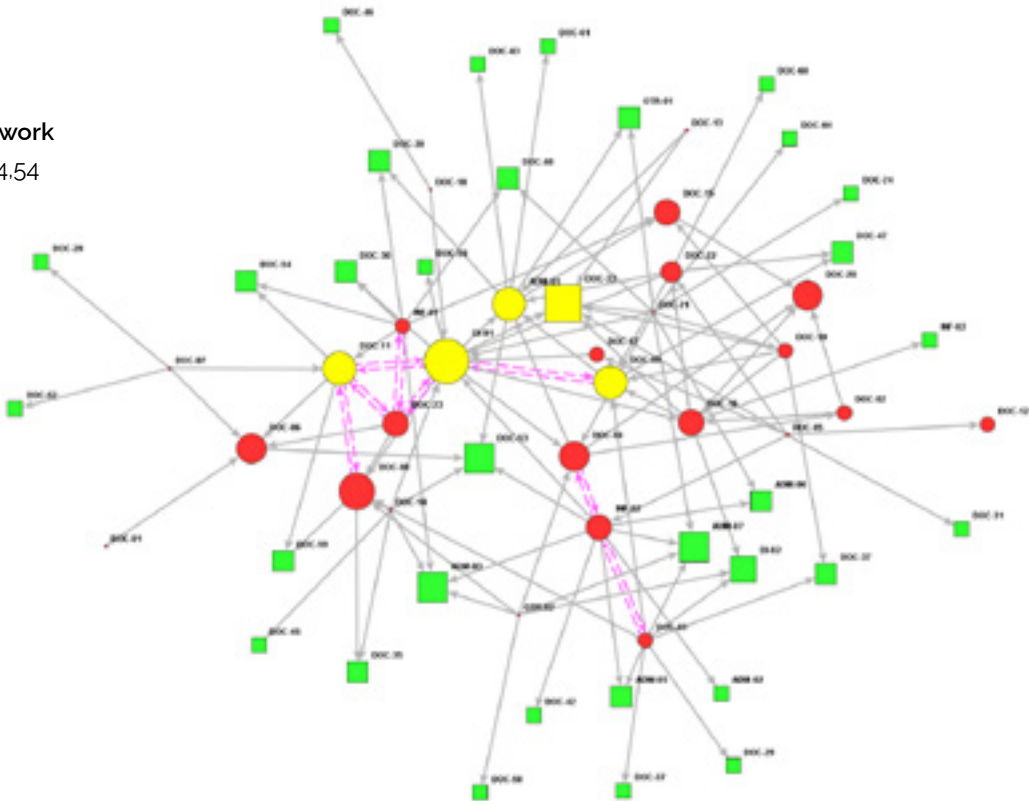
Table 4
Average of ties per network for each case

	Case 1	Case 2	Case 3
Information Network	4.54	3.84	4.09
Planning Network	4.08	3.01	2.9
Innovation Network	3.01	2.86	1.7

In an attempt to graphically show the representation of the low density of the networks mentioned above, Figure 1 shows how the variation for Case 1 is appreciated.

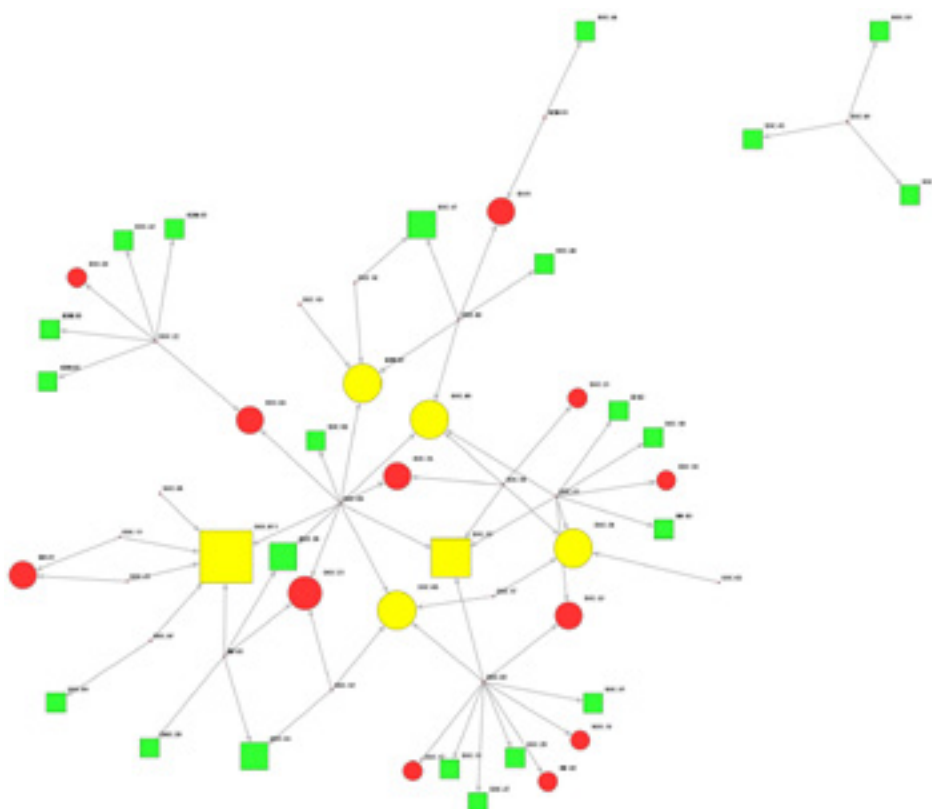
Figure 1
Graphic representation of the networks for Case 1

Information Network
Average of ties: 4.54



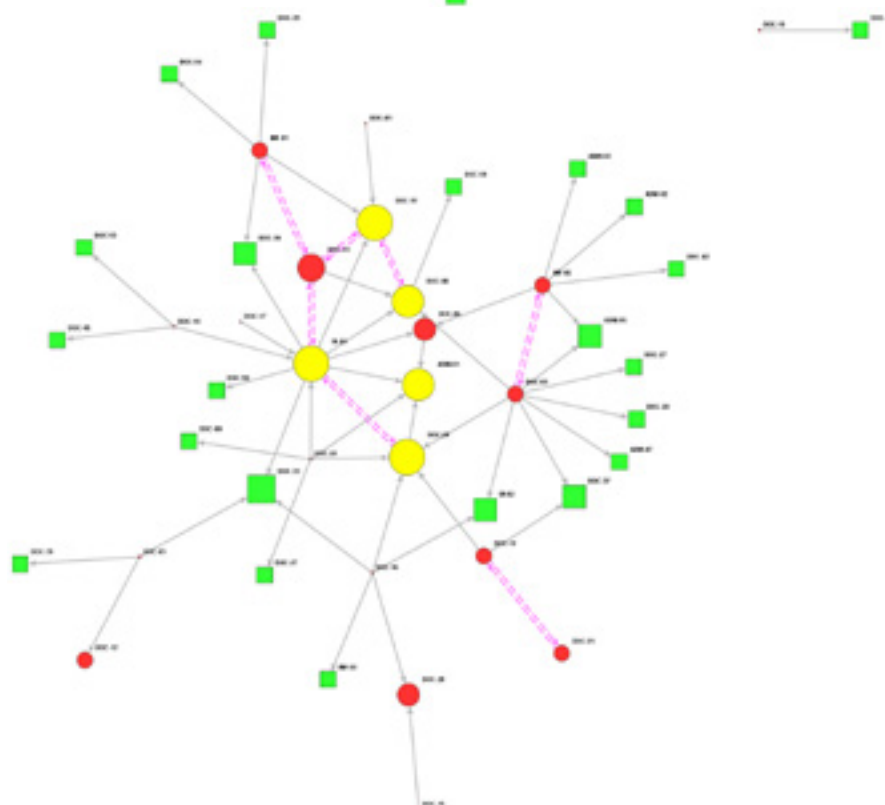
Planning Network

Average of ties: 4.08



Innovation Network

Average of ties: 3.01



Note. In the color coding, red corresponds to surveyed people from which ties are represented, green is the people mentioned by the respondents, and yellow is more central to the network. The node's size identifies each actor's importance according to the indicator of centrality. That is, the more the number of ties received compared to the other network actors, the greater its value of centrality. The solid arrows represent the direction of the relation; if they are dashed, it means it is reciprocal.

Contribution of the analysis of each network

In the Information Network, it is appreciated that there are almost no differences in the average of ties when comparing the different centers (Table 4). This network shows the highest average number of contacts per actor and the highest density, which reflects a relevant level of cohesion when considering all the people who work in the center. This becomes relevant if one considers that the Information Network lays the necessary foundations for innovation to take place (Carolan, 2014; Sun *et al.*, 2014).

The central points in these networks are, in all cases, occupied by teachers and administrative staff.

In Case Studies 1 and 2, it is appreciated that principals also occupy a position of centrality. When triangulating the data that emerge from the network analysis with what comes from the interviews, it is possible to appreciate that for these cases, the role of the principal is also seen as relevant by the different stakeholders of the center:

"The school administration is really, really open. They are genuinely waiting for us to propose things. But it seems we are waiting to receive proposals to actually start working." (C1EP)

"It is an ideal place to grow professionally in this sense because first, the headmistress is great in that sense. She is always supporting the activities of all teachers". (C2ET2)

It should be noted that the principal of Case Study 3 changed several times (from the beginning until the end of the investigation, three different people in that role were identified).

In Case Studies 2 and 3, the DOT are added as roles that occupy central positions (Table 5), which could indicate that the management of digital technologies becomes instrumental in facilitating the movement of actors in the studied centers, and this, in turn, influences the constitution of professional learning communities (Van Waes *et al.*, 2017).

Table 5
Central positions in the Information Network, according to the case

Cases	1	2	3
Range	High	Medium	Low
Actors in central positions	Teachers, Administrative Staff, and Principals	Teachers, Administrative Staff, Principals and DOT	Teachers, Administrative Staff, and DOT
Average of ties	4.54	3.84	4.09

Regarding the Planning Network, it is possible to appreciate that those who occupy positions of centrality are the teachers (Table 6).

In Case Study 2, just as happened with the Information Network, the Planning Network is the one that shows more significant levels of diversity in the type of actors occupying positions of centrality. In this case, the presence of the principal is identified, as well as one of the institution's DOT. Case Study 2 was characterized as medium level based on the self-perception survey filled by the principals. However, these results show that

concerning these aspects, it could be said that it presents advantages compared to the case that occupies level 1. It is worth mentioning that the difference in the degree of appropriation verified in Case 1 was very small compared to Case 2.

Table 6
Positions of centrality in the Planning Network according to the case

Cases	1	2	3
Range	High	Medium	Low
Actors in central positions	Principals, Teachers, and Administrative Staff	Teachers, Administrative Staff, Principals, and DOT	Teachers and Administrative Staff
Average of ties	4,08	3,01	2,90

On the other hand, the Innovation Network of the centers identified in the first stage as high and medium regarding technological inclusion have central positions of the network actors from more than one level (teachers, principals, and administrative staff). However, in the case of the center that was identified as low in the index, those who occupy the central points are all teachers (Table 7). As stated by De Dios (2020) and Lizcano & Hennig (2022), to diagnose interactions tending to collaboration in the centers, visualizing and understanding the relationships between teachers is crucial to promoting individual and professional capital in the organizations.

Table 7
Positions of centrality in the Innovation Network according to the case

Cases	1	2	3
Range	High	Medium	Low
Actors in central positions	Teachers, Administrative Staff, and Principal	Teachers and Administrative Staff	Teachers
Average of ties	3,01	2,86	1,7

Data for Case Studies 1 and 2 show that, for tasks associated with innovation initiatives, other actors different from teachers emerge in positions of centrality in the networks.

After analyzing the three types of networks for each case, it is possible to appreciate that there is a relationship between the levels of the centers identified in Stage 1 (high, medium, and low) and the number of ties identified in the different networks. Even though the center classified as low-level has a high number of ties in the information network, in the planning and innovation ones, it is clearly appreciated that there is a higher number of ties in the center classified as high-level, followed by the medium-level one, and last, the low-level one (Table 4).

Conclusions

The main contribution of this research is to provide empirical evidence of the existence and characteristics of professional learning communities in three teacher education centers in Uruguay, as well as the factors that influence their development. Additionally, this study contributes to understanding the dynamics and challenges of professional learning communities in the Uruguayan context. The findings suggest that the level of digital inclusion for learning is positively associated with the diversity and strength of the networks among teachers and professors, especially in terms of information exchange and collaboration in planning. Moreover, the results indicate that innovation initiatives are not widespread or well-supported in the studied centers, which may limit the potential for improvement and change in teacher education practices.

In summary, from the data analysis, it is possible to affirm that the case studies show characteristics that, in keeping with Dufour & Reeves (2016), can be identified as professional learning communities lite.

Evidence shows that it is possible to appreciate professional communities, even incipient ones. They are present in the information networks of the three centers that show a high level of cohesion given by the number of ties per person and the network density. Another aspect is the diversity of the type of actors in the different networks since, in no case is this limited only to teachers.

On the other hand, an indicator of limited development is the decrease of the density in the networks. Though high in the circulation of information, the density is then lost in the planning and innovation. Another indicator may be that most of the ties occur within the academic department, which, although logical, could be detrimental to the community's cohesion as a whole. From the qualitative data, it is also possible to find indicators showing an incipient community development in the three cases studied.

The limitations of this research can be listed in the following. First, selecting of one case per level of digital inclusion may introduce bias or overlook variations within each level since afterward, the focus of the social network analysis discards the active use of technology regarding the innovation or the planning aspects surveyed. Second, the information-gathering techniques used for the analysis in this article (interviews and survey) may be subject to social desirability or recall bias and may not capture the actual behaviors or practices of the participants in their professional communities. Finally, the team is aware that the definition of professional learning communities lite may not be universally accepted or validated and may limit the generalizability or applicability of the findings to other contexts or settings.

Nevertheless, this study has important implications for policymakers, educational leaders, and researchers interested in promoting professional learning communities as a strategy to enhance teacher education quality and outcomes. Further studies are needed on professional learning communities in the field of education, using different methodologies and approaches to deepen the understanding of their characteristics, processes, and effects on education in general. Moreover, studying this kind of community in the context of initial teacher training is important.

Notes:

Final approval of the article:

Verónica Zorrilla de San Martín, PhD, Editor in Charge of the journal.

Authorship contribution:

The conceptualization of the proposal was managed by Claudia Cabrera Borges and Andrea Tejera Techera. The methodology was developed by Claudia Cabrera Borges, with contributions from Mariela Questa-Tortero. In processing the research data, Claudia Cabrera Borges and Mariela Questa-Tortero were leading the strategy. In writing the original draft, the three authors participated equally, to the same extent that they contributed to the revision and editing process. The administration of the project and the management of the financing was overseen by Andrea Tejera Techera. All authors declare that they have read and accepted the published version of the manuscript.

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References

- ANTINLUOMA, M., ILOMAKI, L., LAHTI-NUUTTILA, P., & TOOM, A. (2018). Schools as professional learning communities. *Journal of Education and Learning*, 7(5), 76-91. <https://doi.org/10.5539/jel.v7n5p76>
- ANTOCI, A., SABATINI, F., & SODINI, M. (2012). See you on Facebook! A framework for analyzing the role of computer-mediated interaction in the evolution of social capital. *The Journal of Socio-Economics*, 41(5), 541-547.
- BAKER-DOYLE, K. (2014). Stories in networks and networks in stories: a tri-modal model for mixed-methods social network research on teachers. *International Journal of Research & Method in Education*, 38(1), 72-82. <http://dx.doi.org/10.1080/1743727X.2014.911838>
- BAUERNSCHUSTER, S., FALCK, O., & WOESSMANN, L. (2014). Surfing alone? The Internet and social capital: evidence from an unforeseeable technological mistake. *Journal of Public Economics*, 117, 73-89. <https://doi.org/10.1016/J.JPUBECO.2014.05.007>
- BROWN, B., HORN, R., & KING, G. (2018). The effective implementation of professional learning communities. *Alabama Journal of Educational Leadership*, 5(August 2018), 53-59.

- BURKE, M., KRAUT, R., & MARLOW, C. (2011). Social capital on Facebook: Differentiating uses and users. In *Proceedings of the SIGCHI Conference on human factors in computing systems* (pp. 571-580). <https://doi.org/10.1145/1978942.1979023>
- CABRERA BORGES, C., CABRERA BORGES, A., CARÁMBULA, S., PÉREZ, A., & PÉREZ, M. (2018). Tecnologías digitales: análisis de planes de profesorado de Uruguay. *Cuadernos de Investigación Educativa*, 9(2), 13-32. <https://dx.doi.org/10.18861/cied.2018.9.2.2858>
- CAMACHO, D., PANIZO-LLEDOT, Á., BELLO-ORGAS, G., GONZALEZ-PARDO, A., & CAMBRIA, E. (2020). The four dimensions of social network analysis: An overview of research methods, applications, and software tools. *Information Fusion*, 63, 88-120. <https://doi.org/10.1016/j.inffus.2020.05.009>
- CAROLAN, B. (2013). *Social network analysis and education: Theory, methods, and applications*. Sage.
- CARRINGTON, P., SCOTT, J., & WASSERMAN, S. (2005). *Models and methods in social network analysis*. Cambridge University Press.
- CHOLIFAH, P., & OKTAVIANI, H. (2019). Mapping the innovation of professional learning communities (PLC) in primary schools: A review. In E. Retnowati, Suprpto, M. Jerusalem, K. Sugiyarto & Wagiron (Eds.), *Innovative teaching and learning methods in educational systems* (pp. 184-189). Routledge. <https://doi.org/10.1201/978042928997>
- CIVÍS, M., LÓPEZ, S., & DÍAZ-GIBSON, J. (2017). El capital social dels estudiants del darrer curs de Magisteri. Una aproximació a les seves xarxes socials en el marc de la facultat [The social capital of the students of the last course of Teacher Training. An approach to their social networks within the framework of the faculty]. *REIRE Revista d'Innovació i Recerca en Educació*, 10(1), 34-56.
- CONSEJO DE FORMACIÓN EN EDUCACIÓN [CFE]. (2008). *Sistema nacional de formación docente 2008. Documento final* [National Teacher Training System 2008. Final document]. http://www.cfe.edu.uy/images/stories/pdfs/plan_nacional/sundf_2008.pdf
- D'ARDENNE, C., BARNES, D., HIGHTOWER, E., LAMASON, P., MASON, M., PATTERSON, P., & ERICKSON, K. (2013). PLCs in action: Innovative teaching for struggling Grade 3-5 readers. *The Reading Teacher*, 67(2), 143-151.
- DE DIOS, T. (2020). Transformación de un modelo educativo a través de la formación y las comunidades docentes de aprendizaje [Transformation of an educational model through training and learning communities]. *Revista Interuniversitaria de Formación del Profesorado*, 34(2), 61-78. <https://doi.org/10.47553/rifop.v34i2.77131>
- DEL FRESNO GARCÍA, M., DALY, A., & SEGADO SÁNCHEZ-CABEZUDO, S. (2016). Identifying the new Influencers in the Internet Era: Social Media and Social Network Analysis. *Revista Española de Investigaciones Sociológicas*, 153, 23-40. <http://dx.doi.org/10.5477/cis/reis.153.23>
- DOGAN, S., PRINGLE, R., & MESA, J. (2015). The impacts of professional learning communities on science teachers' knowledge, practice and student learning: a review. *Professional Development in Education*, 42(4), 569-588. <http://doi.org/10.1080/19415257.2015.1065899>

- DONOSO, P. (2020). Comunidades Profesionales de Aprendizaje: una estrategia para repensar la escuela, propiciar la justicia social y tributar a la mejora continua [Professional Communities of Learning: a strategy to rethink school, promote social justice and pay tribute to continuous improvement]. *Revista Chilena de Pedagogía*, 1(2), 107-131. <https://doi.org/10.5354/2452-5855.2020.58078>
- DUFOUR, R., & REEVES, D. (2016). The futility of PLC Lite. *Phi Delta Kappan*, 97(6), 69–71. <https://doi.org/10.1177/0031721716636878>
- ELLISON, N., STEINFELD, C., & LAMPE, C. (2007). The benefits of Facebook "friends:" Social capital and college students' use of online social network sites. *Journal of Computed-Mediated Communication*, 12(4), 1143-1168. <https://doi.org/10.1111/j.1083-6101.2007.00367.x>
- FELDMAN, J. (2020). The role of professional learning communities to support teacher development: A social practice theory perspective. *South African Journal of Education*, 40(1), 1-8. <https://doi.org/10.15700/saje.v40n1a1668>
- FROELICH, D., VAN WAES, S., & SCHÄFER, H. (2020). Linking Quantitative and Qualitative Network Approaches: A Review of Mixed Methods Social Network Analysis in Education Research. *Review of Research in Education*, 44(1), 244–268. <https://doi.org/10.3102/0091732X20903311>
- FUNDACIÓN CEIBAL. (2020). Un nuevo escenario educativo: los desafíos del COVID-19 y la transición hacia una educación combinada [A new educational scenario: The challenges of COVID-19 and the transition towards a combined education]. + *Aprendizajes*, 2(4).
- GARAY, S., QUEUPIL, J., MAUREIRA, O., GARAY, C., & GUÍÑEZ, C. (2019). El liderazgo distribuido desde la perspectiva del análisis de redes: una experiencia en escuelas vulnerables y efectivas de Chile [Distributed leadership from the perspective of network analysis: an experience in vulnerable and effective schools in Chile]. *Profesorado. Revista de Currículum y Formación del Profesorado*, 23(2), 169-188. <https://doi.org/10.30827/profesorado.v23i2.9269>
- GÓMEZ, M., FERRER, R., & HERRÁN, A. (2015). Las redes sociales verticales en los sistemas formales de formación inicial de docentes [Vertical social networks in formal systems of initial teacher training]. *Revista Complutense de Educación*, 26(2015), 215-232. http://dx.doi.org/10.5209/rev_RCED.2015.v26.46330
- HAIRON, S., CHUA, K., & ABBAS, D. (2019). Professional learning communities. In B. Wong, S. Hairon & P. Tee Ng (Eds.), *School leadership and educational change in Singapore* (pp. 107-122). Springer. https://doi.org/10.1007/978-3-319-74746-0_7
- HARGREAVES, A., & FULLAN, M. (2012). *Professional capital: Transforming teaching in every school*. Teachers College Press.
- HARGREAVES, A., & O'CONNOR, M. (2018). *Collaborative professionalism. When teaching together means learning for all*. Corwin.
- LIZCANO, A., & HENNIG, C. (2022). Factores, resultados y evaluación del impacto de las comunidades de práctica en el desarrollo de competencias tecnológicas en educación superior. Una revisión sistemática de literatura [Factors, outcomes, and evaluation of the impact of communities of practice on the development

of technological competencies in higher education. A systematic literature review]. *Revista Interuniversitaria de Formación del Profesorado*, 98(36.2), 207-230. <https://doi.org/10.47553/rifop.v98i36.2.90739>

HOPKINS, M., SPILLANE, J., JAKOPOVIC, P., & HEATON, R. (2013). Infrastructure redesign and instructional reform in mathematics: Formal structure and teacher leadership. *The Elementary School Journal*, 114(2), 200-224.

KRICHEKY, G., & MURILLO, F. (2011). Las comunidades profesionales de aprendizaje. Una estrategia de mejora para una nueva concepción de escuela [Professional learning communities. An improvement strategy for a new conception of school]. *Revista Iberoamericana sobre Calidad, Eficacia y Cambio en Educación*, 9(1), 66-83.

LIU, Y., DALY, A., CANRINUS, E., FORBES, C., MOOLENAAR, N., CORNELISSEN, F., & HSIAO, J. (2016). Mapping the social side of pre-service teachers: connecting closeness, trust, and efficacy with performance. *Teachers and Teaching*, 23(6), 1-23. <https://doi.org/10.1080/13540602.2016.1218329>

LÓPEZ, S., CIVÍS, M., & MOLINA, J. (2018). La influencia del capital social en el desarrollo profesional de maestros noveles: una aproximación con métodos mixtos desde el análisis de redes sociales [The influence of social capital on the professional development of novice teachers: a mixed-methods approach from social network analysis]. *Profesorado. Revista de Currículum y Formación de Profesorado*, 22(2), 111-132. <https://doi.org/10.30827/profesorado.v22i2.7717>

MORALES, L. (2011). Análisis de redes sociales como posibilidad teórico-metodológica para la investigación [Analysis of social networks as a theoretical-methodological possibility for research]. *Actualidades Investigativas en Educación*, 11(3), 1-15. <https://doi.org/10.15517/AIE.V11I3.10224>

MORALES, M., RIVOIR, A., LÁZARO, J., & GISBERT, M. (2020). ¿Cuánto importa la competencia digital docente? Análisis de los programas de formación inicial docente en Uruguay [How much does digital teacher competence matter? Analysis of initial teacher training programs in Uruguay]. *Innoeduca. International Journal of Technology and Educational Innovation*, 6(2), 128-140. <https://doi.org/10.24310/innoeduca.2020.v6i2.5601>

NING, H., LEE, D., & LEE, W. (2015). Relationships between value orientations, collegiality, and collaboration in school professional learning communities. *Social Psychology of Education*, 18, 337-354. <https://doi.org/10.1007/s11218-015-9294-x>

ORGANISATION FOR ECONOMIC COOPERATION AND DEVELOPMENT [OECD]. (2016). *Innovating Education and Educating for Innovation. The Power of Digital Technologies and Skills*. <https://doi.org/10.1787/9789264265097-en>

OWEN, S. (2014). Teacher professional learning communities in innovative contexts: "ah hah moments", "passion" and "making a difference" for student learning. *Professional Development in Education*, 41(1), 57-74. <http://doi.org/10.1080/19415257.2013.869504>

PENUEL, W., SUN, M., FRANK, K., & GALLAGHER, H. (2012). Using social network analysis to study how collegial interactions can augment teacher learning from external professional development. *American Journal of Education*, 119(1), 103-136.

- PRENGER, R., POORTMAN, C., & HANDELZALTS, A. (2018). The effects of networked professional learning communities. *Journal of Teacher Education*, 70(5), 441-452. <https://doi.org/10.1177/0022487117753574>
- QUESTA-TORTEROLO, M. (2018). *Colaboración docente y usos de las TIC en los centros educativos de Uruguay. Estudio de casos múltiples en el contexto del Plan Ceibal* [Tesis doctoral, Universitat Autònoma de Barcelona]. TDX. <https://tdx.cat/handle/10803/664383>.
- QUINN, D., & KIM, J. (2018). Experimental effects of program management approach on teachers' professional ties and social capital. *Educational Evaluation and Policy Analysis*, 40(2), 196-218. <https://doi.org/10.3102/0162373717742198>
- REDES E INCLUSIÓN DIGITAL. (2019). Encuesta a directores de centros públicos de formación docente de Uruguay y Chile [Survey of directors of public teacher training centers in Uruguay and Chile]. <https://ie.ort.edu.uy/innovaportal/file/103403/1/documento-encuesta-redes-e-inclusion-digital.pdf>
- REDES E INCLUSIÓN DIGITAL. (2020). *Encuesta Redes* [Network Survey]. <https://ie.ort.edu.uy/innovaportal/file/103568/1/encuesta-redes-fase-2.pdf>
- RIGNEY, J., FICHTMAN, N., & VAN DER HAUWAERT, R. (2021). Cross-country collaboration in pursuit of powerful teacher professional learning: Lessons from the European Union. *Teaching and Teacher Education*, 97(January 2021), Article 103212. <https://doi.org/10.1016/j.tate.2020.103212>
- RODRÍGUEZ-GÓMEZ, D. (2015). *Gestión del conocimiento y mejora de las organizaciones educativas* [Knowledge management and improvement of educational organizations]. La Muralla.
- SANNEN, J., DE MAEYER, S., STRUYF, E., DE SCHAUWER, E., & PETRY, K. (2021). Connecting teacher collaboration to inclusive practices using a social network approach. *Teaching and Teacher Education*, 97, Article 103182.
- SCOTT, J. (1990). *Social network analysis*. Sage.
- SILVA, J., USART, M., & LÁZARO, J. (2019). Competencia digital docente en estudiantes de último año de Pedagogía de Chile y Uruguay [Digital teaching competence in final year students of Pedagogy from Chile and Uruguay]. *Comunicar*, 61, 33-43. <https://doi.org/10.3916/C61-2019-03>
- SILVA, J., LÁZARO, J., MIRANDA, P., & CANALES, R. (2018). El desarrollo de la competencia digital docente durante la formación del profesorado [The development of digital teacher competence during teacher training]. *Opción*, 34(86), 423-449. <https://doi.org/10.1016/j.tate.2020.103182>
- SINNEMA, C., DALY, A., LIOU, Y., & RODWAY, J. (2020). Exploring the communities of learning policy in New Zealand using social network analysis: A case study of leadership, expertise, and networks. *International Journal of Educational Research*, 99, Article 101492. <https://doi.org/10.1016/j.ijer.2019.10.002>
- SPELLANE, J., HOPKINS, M., & SWEET, T. (2014). Intra- and inter-school interactions about instruction: Exploring the conditions for social capital development. *American Journal of Education*, 122, 71-110. <https://doi.org/10.1086/683292>
- SUN, M., WILHELM, A., LARSON, C., & FRANK, K. (2014). Exploring colleagues' professional influence on mathematics teachers' learning. *Teachers College Record*, 116(6), 1-30.

- TOMÀS, J., NICOLAU, D., & EXPÓSITO, M. (2016). Las relaciones sociales de los estudiantes en la universidad: intensidad, interrelación y vinculación con el rendimiento académico [The social relations of students at the university: intensity, interrelation and link with academic performance]. *Cultura y Educación*, 28(4), 667-701.
- VAILLANT, D. (2019). Directivos y comunidades de aprendizaje docente: un campo en construcción [Teacher educators and learning communities: A field under construction]. *Revista Eletrônica de Educação*, 13(1), 87-106. <http://dx.doi.org/10.14244/198271993073>
- VANGRIEKEN, K., DOCHY, P., RAES, E., & KYNDT, E. (2015). Teacher collaboration: A systematic review. *Educational Research Review*, 15(June 2015), 17-40. <https://doi.org/10.1016/j.edurev.2015.04.002>
- VANGRIEKEN, K., MEREDITH, C., PACKER, T., & KYNDT, E. (2017). Teacher communities as a context for professional development: A systematic review. *Teaching and Teacher Education*, 61(January 2017), 47-59. <https://doi.org/10.1016/j.tate.2016.10.001>
- VAN WAES, S., DE MAEYER, S., MOOLENAAR, N., VAN PETEGEM, P., & VAN DEN BOSSCHE, P. (2018). Strengthening networks: A social network intervention among higher education teachers. *Learning and Instruction*, 53, 34-49. <https://doi.org/10.1016/j.learninstruc.2017.07.005>
- WASSERMAN, S., & FAUST, K. (1998). *Social network analysis: Methods and applications*. Cambridge University Press.