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Research paper

Teachers involved in school improvement: Analyzing mediating mechanisms of teachers' boundary-crossing activities between leadership perception and teacher involvement

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HIGHLIGHTS

- Teachers are crucial drivers for change in the school improvement process.
- Teachers vary substantially in their involvement in changing educational practice.
- There is a positive association between teachers' leadership perception and their involvement.
- The relationship between leadership perception and involvement is partially mediated by boundary-crossing activities.
- Boundary-crossing activities are vital to increasing teacher involvement in school improvement.

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ABSTRACT

Teachers are drivers for change in school improvement. However, not all teachers participate in further developing schools' educational practice. This study aimed to understand conditional factors in teachers' involvement. To this end, we analyzed teachers' leadership perception and boundary-crossing activities aimed at increasing professional capital. Structural equation modeling analyses based on a sample of $N = 1232$ teachers at $N = 59$ schools indicated partial mediations of cognitive and social boundary-crossing activities on the relationship between leadership perception and involvement. This study contributes to the literature by illuminating the potential of teachers' activities to enhance professional capital for school improvement.

1. Introduction

Successful school improvement is about changing teachers' working conditions and improving their pedagogical repertoire so that students may learn better (Hopkins & Reynolds, 2001). As for students' learning, teachers have been considered to be essential drivers for change, as they have the most leverage on a classroom level (Creemers et al., 2007; OECD, 2020; Richter et al., 2014; Somech, 2010). Research also shows that teachers are crucial change agents on a school level beyond the classroom (Bryk et al., 2010; Darling-Hammond et al., 2017; Mitchell & Sackney, 2011). However, teachers' impact on school improvement differs in the degree and quality of their active participation in change processes (Lin, 2014; Rice & Schneider, 1994; Somech & Ron, 2007; Wenner & Campbell, 2017). Previous research found that teachers do not always make full use of their potential in initiating, planning, and implementing educational change (Muijs & Harris, 2006; Sleegers et al., 2014; Tyack & Tobin, 1994). Thus, as desirable and essential it is that teachers participate in school improvement processes, it remains a major challenge to get them involved.

Several researchers have analyzed this problem from a leadership perspective (i.e., Devos et al., 2014; Hallinger & Heck, 2010; Pietsch et al., 2019; Vanblaere & Devos, 2018). In their *leadership for*

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learning framework, Hallinger and Heck (2010) focused on how principals can foster working conditions in which staff members are encouraged to actively participate in school improvement. Pietsch et al. (2019) conceptualized leadership for learning as a "contextually contingent mix of instructional, transformational, and shared leadership practice that may have differential effects at various organizational levels" (p. 705)—such as effects on teachers' job satisfaction or organizational commitment. A basic assumption here is that teachers' interaction with a more or less stimulating leadership practice is associated with teachers' organizational commitment in terms of their involvement in school improvement efforts.

Yet, previous research has found that differences in leadership practices alone cannot adequately explain why teachers vary in their involvement in school improvement (Berkovich & Bogler, 2021; Devos et al., 2014; Li et al., 2016; Ross & Gray, 2006). Teachers may remain passive no matter how strongly a principal encourages them to participate in school improvement—or vice versa (Klar et al., 2016; Lin, 2014; Moolenaar et al., 2014; Swanepoel, 2008). Thinking of a principal's efforts to have the teaching staff more engaged in school improvement as an invitation to take part in a professional learning process, an understanding is needed of how teachers respond to the invitation—or how they act when encouragement from the principal is lacking (Hallinger & Heck, 2010; Mitchell & Sackney, 2011). Hence, we argue that the black box between teachers' perception of the school leadership and their own involvement is a relevant theoretical and empirical shortcoming in school improvement research. Therefore, the aim of this study is to shed light on the way that teachers make use of a principal's invitation to be active participants in school improvement processes by identifying relevant mediating mechanisms that explain differences in involvement.

To this end, we believe that focusing on teachers' learning activities will aid identification of such mechanisms. We argue that the concept of *boundary-crossing activities* (Akkerman & Bakker, 2011; Wenger, 1999) is a way of emphasizing teachers' learning activities when unpacking the black box of why teachers differ in their response to a principal's encouragement to take an active role in school improvement.

The concept of boundary crossing usually refers to learning processes across different sites, in which boundaries between different groups are perceived not only as barriers but also as learning opportunities (Akkerman & Bakker, 2011). Hence, working the interface between a diverse landscape of actors, groups of actors, and organizations involves a complex set of boundary-crossing activities (Wenger, 1999) that are cognitive (i.e., searching for new professional knowledge) as well as social (i.e., linking disconnected actors).

Crossing boundaries is essentially about increasing teachers' professional capital, which includes most notably human and social capital (Hargreaves & Fullan, 2015; Spillane et al., 2003). Whereas cognitive aspects relate to human capital, it is the social aspects of these activities that can be referred to social capital.

Human capital is conceptualized as a teacher's qualifications, experience, and ability to teach. From this perspective, further developing professional capital is about increasing teaching and working abilities by formal and informal learning at the workplace and beyond (Kyndt et al., 2016). However, researchers have indicated that extending human capital in isolation is limited (Mitchell & Sackney, 2011; Vangrieken & Kyndt, 2020). To grow, human capital "has to be circulated and shared" (Hargreaves & Fullan, 2015, p. 3). Thus, professional capital is not only about human capital but also about social capital.

Social capital may appear in various forms of social structures: For instance, individuals may have direct access to important other actors (Bourdieu, 1986), be part of a dense clique in a network (Coleman, 1988), or control exclusive connections to actors otherwise disconnected from the group (Burt, 1992). The logic is the same as with human capital: The existence or absence of social capital has an impact on a teacher's professional development. Thus, an individual's social structures may facilitate or hinder professional learning at the workplace (i.e., Berkovich & Bogler, 2021; Kyndt et al., 2016).

Several researchers have indicated that individuals' boundary-crossing activities for increasing both human and social capital are related to their involvement in change processes (i.e., Akkerman & Bakker, 2011; Obstfeld et al., 2014; Wenger, 1999). Moreover, previous studies found that teachers who perceive their principals as encouraging staff development more actively cross boundaries—both cognitively (i.e., Muijs & Harris, 2006; Sleegers et al., 2014) and socially (i.e., Slavit & Roth McDuffie, 2013; Spillane & Kim, 2012). Hence, we argue that teachers' boundary-crossing activities are possible mediators of the relationship between leadership perception and teacher involvement in school improvement.

To sum up, the contribution of this study is to further examine why teachers differ in their involvement in school improvement. To this end, we first analyzed how teachers' perception of the school's leadership practice is directly associated with teachers' participation in school improvement. Second, we examined both cognitive and social aspects of teachers' boundary-crossing activities as possible mediators of this relationship. As previous research indicated that leadership perception can explain variances in teacher involvement only marginally, we argue that this second step is essential for a better understanding of differences in teacher involvement in school improvement.

2. Literature review

In this section we first present theoretical and empirical findings on the role and benefits of teacher involvement in school improvement (2.1). We then discuss the impact of teachers' leadership perception on their involvement (2.2). We go on by clarifying conceptual assumptions concerning teachers' crossing boundaries in the context of school improvement (2.3). Finally, mediating mechanisms of these activities on the relationship between leadership perception and teacher involvement are presented from a theoretical perspective (2.4).

2.1. Teacher involvement in school improvement

School improvement is essentially about further developing the staff's teaching and working-related repertoire in a way that improves both teachers' working conditions and instructional quality (Hopkins & Reynolds, 2001). This in turn leads to better student learning and achievement. Researchers have argued that establishing and maintaining school improvement processes in a context-sensitive and sustainable way cannot depend on a single actor only—such as the principal (Bryk et al., 2010; Mitchell & Sackney, 2011; Wenner & Campbell, 2017). In the long run, teachers need to participate by taking an active role in further developing educational practice (Darling-Hammond et al., 2017).

Being involved in school improvement processes is about teachers taking responsibility in collective sensemaking (Coburn, 2005) and decision-making processes (Somech, 2010). Being actively involved in a professional learning community means contributing to shaping a school's mission, reflecting on the school's educational practice, and collaborating to further develop teaching activities (Louis et al., 1996). Hence, we define a teacher's involvement in school improvement as the degree to which a teacher participates in further developing educational practice

collectively.

School improvement has been described as being more organic than mechanic in nature (Mitchell & Sackney, 2011)—organic in the sense that school improvement often takes informal rather than formal paths or connections between staff members (Spillane & Kim, 2012). Some studies based on social network analysis in the context of school improvement have indicated that certain actors play crucial roles by acting informally as knowledge brokers in the form of gatekeepers or representatives when new ideas, reforms, or teaching materials have to be implemented (Daly et al., 2014; Moolenaar et al., 2014; Spillane & Kim, 2012). There is a broad consensus that some teachers take on the role of vital change-makers without being formally mandated to do so (Darling-Hammond et al., 2017). However, the evidence base concerning these bridge-building and gatekeeping teachers is inadequate (Carmichael et al., 2006; Farley-Ripple & Grajeda, 2019; Grootenboer et al., 2019; Spillane & Kim, 2012). Teachers as formative actors in school improvement have therefore been referred to as "hidden in plain sight" (Jusinski, 2019). We argue that by focusing on these bridge-building processes, we can come closer to understanding the organic nature of social structures within schools in terms of variance in teachers' involvement in school improvement.

Regarding the empirical evidence, our literature review on teacher's involvement in changing educational practice revealed that teachers vary substantially in their involvement, dependent on several factors: On a personal level, teachers' positive attitudes towards change (i.e., Liu & Werblow, 2019; Ross & Gray, 2006), high expertise in further developing working skills (i.e., Lin, 2014; Wenner & Campbell, 2017), and a willingness to cooperate with other staff members (i.e., Moolenaar et al., 2014; Wenner & Campbell, 2017) positively impact their degree of active involvement in school improvement. Regarding teachers' working experience and their involvement in school improvement, mixed results have been reported: Whereas Hulpia et al. (2009) revealed a negative impact of tenure on organizational commitment, other studies found a positive relationship between teachers' seniority and their involvement in further developing organizational practice (i.e., Moolenaar et al., 2014; Vanblaere & Devos, 2018). On an organizational level, supportive leadership practices and shared decision-making (i.e., Hulpia et al., 2009; Liu & Werblow, 2019), a culture of trust (i.e., Li et al., 2016; Muijs & Harris, 2006), formal and informal school structures (i.e., Devos et al., 2014; Vanblaere & Devos, 2018), and collective teacher efficacy (i.e., Ross & Gray, 2006) empower teachers to take an active part in changing educational practice.

Based on these empirical findings, in this study we aimed to address the empirical shortcoming that so far little is known about how multiple predictors of teacher involvement interact when analyzed simultaneously (i.e., Mitchell & Sackney, 2011; Sleegers et al., 2014). Hence, we not only analyzed how teachers' leadership perception (2.2) and professional learning activities in terms of boundary-crossing (2.3) predict teacher involvement but also how these factors are intertwined and may explain differences in teacher involvement in school improvement more substantially when analyzed together (2.4).

2.2. Leadership perception and teacher involvement

School leadership has a significant indirect impact on student learning outcomes by influencing the staff's capacity to change (Creemers & Kyriakides, 2007; Eyal & Roth, 2011; Hallinger & Heck, 2010; Leithwood et al., 2020). The staff's capacity to change refers to regulation processes, defined as the staff's abilities on an individual and collective level to reflect on their professional capital and change educational practice, if needed, to improve student learning (Amels et al., 2020; Maag Merki et al., 2021; Mitchell & Sackney, 2011).

The concept of *leadership for learning* focuses explicitly on these regulation processes: It refers to fostering a more distributed and collaborative leadership practice among the staff that enhances the capacity to change on an individual and collective level (Hallinger & Heck, 2010; Pietsch et al., 2019). The knowledge base on facilitating factors to increase this capacity reveals that being continually encouraged by the principal to enhance professional capital by seeking and sharing new knowledge, teaching materials, and best practice ideas helps teachers to gradually accept more and more responsibility, not only for their own professional development but also for school improvement (Bryk et al., 2010; Eyal & Roth, 2011; Leithwood et al., 2020; Leithwood & Jantzi, 2005; Robinson et al., 2008; Somech & Ron, 2007; Wenner & Campbell, 2017).

The theoretical framework of *leadership for learning* is a blend of three different conceptual models: instructional, transformational, and shared leadership (Pietsch et al., 2019). These leadership concepts include the principal's role in ensuring that teachers can focus on the importance of student learning (*instructional leadership*) and in adopting a capacity-building perspective to establish an environment where teachers may improve their working and teaching skills (*transformational leadership*) and in which the responsibilities to improve as an organization are increasingly shared among the teaching staff (*shared leadership*) (Hallinger & Heck, 2010; Leithwood & Jantzi, 2005; Spillane, 2005).

We acknowledge that leadership practice contains other dimensions, such as establishing goals and expectations, resourcing strategically, coordinating and evaluating teaching, fostering the effectiveness of teaching, and ensuring an orderly and supportive environment (Robinson et al., 2008). However, in this study we address principals' encouragement only, as it explicitly focuses on the principal-to-teacher relationship and aims to enhance teachers' professional capital and increase teacher involvement in school improvement (i.e., Mitchell & Sackney, 2011; Singh & Billingsley, 1998; Sleegers et al., 2014).

Associations between teachers' perception of a principal encouraging professional learning and actual teacher involvement have been described in many theoretical frameworks on effective school improvement (Bryk et al., 2010; Reezigt & Creemers, 2005) and on effective teachers' professional development and capacity building (Darling-Hammond et al., 2017; Higgins et al., 2012; Mitchell & Sackney, 2011). For instance, Mitchell and Sackney (2011) conceptualized a stimulating environment as an essential component of an affirmative climate in which individuals are explicitly asked to participate and in which their opinions are valued. Being invited to contribute their own ideas and doubts "brings teachers into a caring professional relationship" (Mitchell & Sackney, 2011, p. 67). However, in contrast to the rich literature on theoretical assumptions related to leadership perception and teacher involvement, the evidence base remains sparse (i.e., Devos et al., 2014; Grootenboer et al., 2019; Sleegers et al., 2014; Vanblaere & Devos, 2018). Sleegers et al. (2014), for instance, indicated that regarding leadership practices, "most of the variance in teachers' engagement in professional learning was explained by the intellectual stimulation dimension" (p. 637).

Although principals may be pivotal in creating conditions necessary for professional learning, little evidence is available on what concrete professional activities should be enhanced to make collective professional learning with a high degree of teachers' participation and responsibility possible (Creemers et al., 2007; Klar et al., 2016). Therefore, in sections 2.3 and 2.4 below we elaborate on the indirect relationship between teachers' leadership perception and their involvement in school improvement processes

by focusing on staff members' actual behavior when further developing professional capital.

2.3. Conceptual clarification of boundary-crossing activities

Professional capital is a function of human and social capital (Spillane, 2015). Whereas human capital is enhanced when teachers are cognitively active, social capital is increased when teachers establish new social structures. Here we outline why we assume that teachers' boundary-crossing activities might lead to a better understanding of relevant cognitive and social professional learning activities when teachers are encouraged to be involved in school improvement.

In Wenger's *communities of practice* theoretical framework (Wenger, 1999), social learning is conceptualized as boundary-crossing activities. At the core of this socio-constructivist theory is the idea of a boundary, conceptualized as sociocultural differences between two or more communities of practice (such as different organizations, actors, or working groups). The argumentation is that actors within a community of practice share a history of learning. Over time, through collective learning processes, an imaginary boundary between their community and other communities evolves. However, no community exists in isolation, as crossing these boundaries is not only essential but inevitable when people are actively involved in establishing or changing a community's practice. For instance, by crossing boundaries between communities, actors can look at their own practice from a new point of view. And when taking a different perspective, they may uncover previously unknown strengths and weaknesses of their work. More generally, working the interface between different communities of practice is about skillfully translating, coordinating, and aligning perspectives between different communities of practice (Kubiak, 2009).

To better understand the complex activities involved in crossing boundaries, Wenger (1999) distinguished between cognitive and social aspects: The *cognitive aspect* of boundary-crossing is about individuals enhancing their human capital by being able to see beyond their own community and its practice. For instance, when crossing boundaries they seek new knowledge and in this way quench their thirst for professional novelty and gain a new perspective on their own practice (Akkerman & Bakker, 2011). However, although a focus on teachers' human capital in the form of acquiring new knowledge or an alternative perspective is essential, it is not enough to change a community's practice. As a complement, there is teachers' *social capital*, which is crucial to changing a community's practice (Hargreaves & Fullan, 2015). Briefly stated, the new ideas need to pass not only an individual's test but also a social test (Mitchell & Sackney, 2011). This means that individuals need to be able to link different actors with new ideas when aiming to change a community's practice. The basic assumption here is that by building bridges between new ideas and groups of individuals a change process is initiated and implemented—potentially changing both professional networks and a community's practice (Obstfeld et al., 2014; Wenger, 1999).

Obstfeld (2005) pointed out that these bridges may appear in different forms: as conduits, *tertius gaudens*, or *tertius iungens*. Whereas conduits ("the third who transfers") facilitate knowledge transfer by acting as neutral messengers, bridges (or brokers) with a *tertius gaudens* orientation ("the third who enjoys") take advantage of their prominent position, for instance by cultivating conflict or keeping other actors separate. This way, brokers make sure they stay in their exclusive and powerful positions, transferring, hoarding, or even manipulating information as it pleases their situation. Previous research has discussed these power dynamics and problematic aspects of brokering activity (Burt, 1992, 2005; Krackhardt, 1999; McGrath & Krackhardt, 2003). However, in this study, we focus on brokers with a *tertius iungens* orientation ("the third who joins"). Brokering activity in this form is used to foster collaboration among others, by introducing different persons to each other and coordinating new collaborative action (Obstfeld et al., 2014).

In brief, if seeking new knowledge is about finding differences between communities of practice, brokering (with a *tertius iungens* orientation) is essentially about translating, coordinating, and aligning various perspectives and ideas from one community to another (Wenger, 1999). The ultimate goal of these activities is to build a fabric of social agencies that facilitates career-long teacher learning (Richter et al., 2014).

When it comes to school improvement, keeping professional knowledge up-to-date can be conceptualized as teachers' access to professional novelty, which constitutes their human capital (Hargreaves & Fullan, 2015) and personal capacity to seek new scientific knowledge or best practice ideas (Mitchell & Sackney, 2011; Sleegers et al., 2014). Ongoing professional learning in the form of a teacher's activity in keeping up-to-date with new teaching ideas is widely considered as a natural component of teachers' professional activities and as a key component in improving a teacher's professional capital in terms of the quality of instruction and cooperation among staff members (Sleegers et al., 2013). Moreover, a teacher's engagement in seeking new knowledge on an individual level is strongly associated with a teacher's involvement in changing educational practice at the school level (Huizinga et al., 2014; Lin, 2014; Muijs & Harris, 2006; Wenner & Campbell, 2017).

Further, in terms of a teacher's social capital and its relation to school improvement, applying brokering activities more frequently is related to larger and more diverse social networks; this gives individuals better access to non-redundant information (Hopkins et al., 2013; van den Boom-Muilenburg et al., 2022). Therefore, we argue that a teacher's bridge-building activity is positively related to other boundary-crossing activities—such as seeking new knowledge. Moreover, brokering activity reportedly has a positive impact on a teacher's motivation, confidence, and experience of autonomy (Hopkins et al., 2013; Slavit & Roth McDuffie, 2013). We therefore assume that brokering activity is related to teachers making use of their potential to be active participants in changing a school's educational practice. This assumption is further supported by Obstfeld's finding that a brokerage *tertius iungens* orientation is positively associated with innovation involvement (Obstfeld, 2005). However, in the context of school improvement, no such evidence is available as yet. Lastly, some researchers have reported that more experienced teachers tend to have larger and more diverse social networks (Van Waes et al., 2015), which gives them the opportunity to be more active in applying brokering strategies (Moolenaar et al., 2014).

2.4. Mediating mechanisms of boundary-crossing activities between leadership perception and teacher involvement

After having outlined conceptual clarification of cognitive and social aspects of boundary-crossing activities, in this section we elaborate on the mediating mechanisms of these activities on the relationship between leadership perception and teacher involvement.

Regarding empirical evidence that focuses simultaneously on the two aspects of being cognitively and socially involved in change processes, Obstfeld (2005) has done relevant work. Based on a Schumpeterian approach to analyzing the social nature of innovation processes in the car industry, Obstfeld conceptualized innovation involvement as a function of a trusting working

environment, years of experience in working at the firm, and both technical and social knowledge. For Obstfeld, technical knowledge is an individual's comfortability in addressing more advanced technical issues related to different areas when designing a new car. Social knowledge is an individual's familiarity with other staff members' relationships and use of the social networks by applying brokering activities in the firm. Obstfeld et al. (2014) described brokering as a "behavior by which an actor influences, manages, or facilitates interactions between other actors" (Obstfeld et al., 2014, p. 140). In accordance with Wenger (1999), Obstfeld (2005) indicated that involvement in change processes is substantially linked to both an individual's cognitive (i.e., acquiring new knowledge) and social activities (i.e., building bridges among colleagues). We argue that Obstfeld's work is valuable when developing a process-oriented model on mediating mechanisms between teachers' leadership perception and their involvement in school improvement. However, we have to acknowledge that a trusting environment is not the same as having a principal stimulating growth when it comes to staff development. Further, the car industry in which Obstfeld conducted his work is not identical to the school context in terms of working conditions, processes, or organizational hierarchies. Thus, in the following, further studies in the domain of school improvement research are presented that support our argumentation.

First, previous research has highlighted the positive relationship between teachers' leadership perception and their activities in keeping pedagogical knowledge and working skills up-to-date (i.e., Blase & Blase, 1999; Muijs & Harris, 2006; Sleegers et al., 2014). For instance, Muijs and Harris (2006) indicated that teachers often perceive their principals to be essential originators of professional learning activities. According to them, it is usually the principals that initiate both individual and collective professional development processes among staff members.

Second, a few studies analyzed principals' role in establishing a working environment in which teachers may act as knowledge brokers and capacity builders among their colleagues (i.e., Farley-Ripple & Grajeda, 2019; Moolenaar et al., 2014; Slavit & Roth McDuffie, 2013; Spillane & Kim, 2012). According to Moolenaar et al. (2014), it is the teachers' perception of the school environment that affects the extent to which they intentionally shape their professional networks (for instance, by building bridges among disconnected others). In addition, Slavit and Roth McDuffie (2013) indicated that teachers' perception of the principal's encouragement to further develop educational practice plays a vital role in whether teachers adopt a brokering role for their own and collective professional learning.

Third, previous research has addressed indirect effects of teachers' leadership perception on teachers' involvement in collective learning processes: Devos et al. (2014) reported a partial mediation of distributed leadership on the relationship between teachers' leadership perception and their commitment to the school. Similarly, Li et al. (2016) found that faculty trust partially mediates the relationship between principal leadership and teacher involvement in collective professional learning activities. Moreover, Ross and Gray (2006) indicated that the leadership-teacher commitment relationship is both direct and indirect; they introduced collective efficacy as a mediating variable to examine the source of the principal's influence on teacher commitment. However, there are no empirical studies available that examine teachers' leadership perception more explicitly in terms of principals' encouragement of staff development and mediating mechanisms more closely related to teachers' social learning—as in terms of boundary-crossing activities.

Bringing all these building blocks together, we assume that the relationship between teachers' perception of principals encouraging them to take an active part in school improvement and teachers' involvement is indirect rather than direct. Following both Wenger's (1999) and Obstfeld's (2005) argumentation and empirical evidence from the various studies outlined above, we propose a partial two-part mediation mechanism on the impact of teachers' leadership perception on teacher involvement: first, through a teacher's search for new knowledge, and second, through a teacher's bridge-building activity.

3. Research question and hypotheses

This study aims to show teachers' potential paths regarding making use of a principal's invitation to be an active part in improving the school's educational practice. We argue that feeling encouraged to participate in social learning processes is not enough. It is also about teachers' learning activities to increase both their human and social capital that then again explain why some teachers are more or less involved in school improvement. To this end, we examine the following overarching research question: What teacher-level factors explain teachers' variance in involvement? Based on the theoretical assumptions and empirical evidence outlined above, we propose the following four hypotheses:

Hypothesis 1. Teachers' involvement is positively related to their perception of the principal's stimulation of professional development.

Hypothesis 2. Teachers' involvement is positively related to keeping professional knowledge up-to-date.

Hypothesis 3. Teachers' involvement is positively related to building bridges among colleagues.

Hypothesis 4. The effect of teachers' leadership perception on their involvement is partially mediated by their search for new knowledge (Hypothesis 4a) and brokering activity (Hypothesis 4b).

4. Material and methods

This study was conducted in the German-speaking part of Switzerland, where in 2006 the Federal Constitution and the Intercantonal Agreement on Harmonization of Compulsory Education (HarmoS Agreement) (EDK, 2011) obliged cantons and their schools to change educational practice (Eurydice, 2020a). For instance, in the subsequent 10 years all schools had to undergo a large-scale curriculum reform (D-EDK, 2016). Every school was granted increased autonomy in adopting this reform. However, low-stake accountability structures in the form of school inspections were introduced to monitor and assess the quality of primary schools and their efforts towards school improvement (Eurydice, 2020b). For this reason, we assumed that all schools in German-speaking Switzerland and their staff were most likely to have recently experienced major school improvement measures, such as changing their organizational structures, articulating shared development goals, experimenting with new teaching techniques, or developing enhanced collaborative work in teams.

4.1. Study design and participants

This study is part of a larger project, where data was collected from multiple school actors—such as principals, teachers, and students (N = 3264), but for this study, we focused on the responses of 1587 teachers at 59 primary schools. All of the participants took part in the study on a voluntary basis and actively gave their informed consent to participate. Data used in this study was collected by online questionnaire. As the data was gathered at the beginning of the school year 2019/20 we relied on a subsample of teachers who had at least 1 year of experience teaching at their school (N = 1482; 87% women; aged 21–67 years [M = 43.11,

Table 1
Descriptive statistics of the sampled primary schools (N = 59).

	Mean (SD)	Median	Min.	Max.
Response rate (in %)	83.8 (10.7)	85.7	46.9	100
Size				
Nstaff	28.9 (17.7)	23	6	74
Nstudent	226.7 (143.7)	184	34	593
SES[a]				
Taxable income	33,489 (10,390)	31,030	16,183	64,735
Social welfare	2.36 (1.66)	1.65	0.5	6.3
Regional context[b]	–	4	1	9

Note. a Socioeconomic background of the school's community (SES) was measured as average taxable income (in Swiss francs, CHF) and social welfare ratio (in %). b Regional context of a school was rated on an ordinal scale from 1 (rural) to 9 (urban).

SD = 11.34]). The survey response rate on an individual level was 83.1%. Thus, our final sample was 1232 teachers. On a school-level the response rate was slightly higher at 83.8% (SD = 10.7%), with response rates per school ranging from 46.9% to 100%.

In terms of school characteristics (see Table 1), the sampled schools varied greatly in size and in regional and social contexts: Whereas some smalls schools had fewer than 10 teachers and only a few more than 30 students, other schools could be considered as large schools, with more than 70 teachers and almost 600 students. The regional context was measured on a scale from 1 (urban) to 9 (rural). Most schools in the sample were located in small-to medium-sized agglomerations (from 3 to 6 on the scale). In terms of the social context, the schools' local communities differed in both their social welfare ratio (from very low 0.5% to relatively high 6.3% of the population) and the average taxable income, which can be considered as representative for German-speaking Switzerland. Hence, although all schools have experienced similar school improvement measures as mentioned above under section 4, in terms of regional and social contexts the schools in our sample faced very different situations and challenges.

Our data was diverse not only in terms of school characteristics but also in terms of teacher demographics. A possible sampling bias was analyzed by comparing teacher demographics (gender, tenure, and percentage of full-time employment) and school characteristics (size, regional context, and socioeconomic background) with data on all Swiss primary schools provided by the Swiss Federal Statistical Office (FSO, 2020). As no significant differences were found, a sampling bias could be excluded. Hence, although the sample was not obtained through random sampling, it was representative both on a school and teacher level for all primary schools in the German-speaking part of Switzerland. Therefore, our database was a solid basis for examining our hypotheses.

4.2. Measures

Teacher involvement in school improvement. To what degree teachers saw themselves as active parts in school improvement processes was assessed using a modified form of Obstfeld's measurement instrument to assess innovation involvement (Obstfeld, 2005). In the original form, Obstfeld assessed an employee's highest level of involvement in various innovations when developing a new car on five different levels: "Initiator," "Major Role," "Minor Role," "No Involvement," or "No Knowledge about Innovation." For our purpose, based on these levels of involvement we developed a new measurement instrument for the context of school improvement. Thus, the teachers were asked, for example, whether they were strongly involved or saw themselves in a "minor role" in activities to further develop educational practice at their school (see Table 2). Based on four items assessed with a 6-point Likert scale ranging from 1 (strongly disagree) to 6 (strongly agree), the instrument showed a high Cronbach's alpha value, indicating a high reliability (DeVellis, 2012) (N = 1136; M = 3.52, SD = 0.97; Cronbach's $\alpha = 0.86$).

Leadership perception. A teacher's perception of the school leadership practice was assessed using a short and slightly modified form of the "Providing for intellectual stimulation" measurement instrument (Sleegers et al., 2014). In the original form, this measurement instrument consisted of eight items assessed with a 4-point Likert scale ranging from 1 (disagree) to 4 (agree) and a Cronbach's alpha value of 0.92. Due to the principle of parsimony in our online questionnaire, our adapted measurement instrument was based on four items only. Further, we assessed with a 6-point Likert scale ranging from 1 (strongly disagree) to 6 (strongly agree). A Cronbach's alpha value of 0.87 revealed a high reliability of the measurement instrument (N = 1136; M = 4.71, SD = 0.83). For instance, teachers were asked whether their principal encouraged the teaching staff to seek and discuss new ideas to further develop their school (see Table 2).

Keeping up-to-date. A teacher's cognitive boundary-crossing activity was assessed using the "Keeping up-to-date" measurement instrument (Sleegers et al., 2014) based on four, instead of the original five, items. Again, in the original version the measurement instrument assessed with a 4-point Likert scale (from 1 = applies to me (almost) never, to 4 = applies to me (almost) always). The Cronbach's alpha value of the original scale was 0.79. In our slightly adapted form, teachers rated, for instance, whether they kept themselves informed about developments in the field of education and teaching on a 6-point Likert scale ranging from 1 (strongly disagree) to 6 (strongly agree) (see Table 2). Results from a pilot study with secondary teachers that we had conducted in 2018 revealed that for the Swiss context, the item "I take part in further training and in-service training even if it is not compulsory" did not work properly (N = 90; M = 4.52, SD = 0.65; Cronbach's $\alpha = 0.79$). A low item-total correlation (0.47) and a low factor loading resulting from an exploratory factor analysis (0.36) indicated that the measurement instrument could be substantially improved when this item was dropped. With the main data the adapted measurement instrument had an acceptable reliability and decent factoring structure and item-total correlations (N = 1163; M = 4.40, SD = 0.82; Cronbach's $\alpha = 0.77$).

Brokering activity. Teachers' bridge-building activities were assessed using a short form of Obstfeld's "Brokerage tertius iungens orientation" measurement instrument (Obstfeld, 2005). In the original version, brokerage orientation was assessed based on six items with a 7-point Likert scale (Cronbach's alpha = .88). Again, due to the principle of parsimony we assessed only four of these items, covering different aspects, such as whether teachers see opportunities for collaboration between people or whether they introduce people to each other who might have a common strategic work interest (see Table 2). Again, the test instrument was assessed using a 6-point Likert scale ranging from 1 (strongly disagree) to 6 (strongly agree). Results revealed a high reliability of the test instrument (N = 1131; M = 3.72, SD = 0.90; Cronbach's $\alpha = 0.84$).

The supplementary materials of this article provide further technical information on the four latent constructs (i.e., confirmatory factor analyses for each measurement instrument, and items' characteristics).

Covariates. Regarding teacher demographics, teaching experience and familiarity with the local context of a school have repeatedly been acknowledged to impact teachers' involvement in school improvement processes (Huizinga et al., 2014; Vanblaere & Devos, 2018). Moreover, previous research has indicated that staff members working part-time are less involved in school improvement (Moolenaar et al., 2014). Therefore, we looked at tenure, assessed as the number of years a teacher had been working at the

Table 2
Measurement instruments to assess perception of leadership practice, keeping up-to-date, brokering activity, and teacher involvement in school improvement with example items and scale characteristics.

Latent construct	Example item	N	M (SD)	Items	Range	α	ICC1 (ICC2)
1. Leadership perception	Our principal encourages teachers to always think about how to improve our school.	1136	4.71 (.83)	4	1–6	.87	.140 (.759)
2. Keeping up-to-date	I keep myself informed on developments within the field.	1163	4.40 (.82)	4	1–6	.77	.013 (.202)
3. Brokering activity	I see opportunities for collaboration between people.	1131	3.72 (.90)	4	1–6	.84	-.008 (-.190)
4. Teacher involvement in school improvement	I am strongly involved in activities to further develop educational practice at our school.	1140	3.52 (.97)	4	1–6	.86	.033 (.397)

Note. M = mean and SD = standard deviation. α indicates Cronbach's alpha of the latent construct. ICC1 and ICC2 are the intraclass correlation coefficients.

school. On average, teachers in our sample had worked for about 10 years at their present school (N = 1143; M = 10.25, SD = 8.78). The information on teachers' percentage of full-time employment (full-time position = 100%) was gathered directly from the principal and recorded with a dichotomous variable (0 = less than 75%, 1 = more than 75%). Teachers employed less than 75% slightly outnumbered the staff employed with at least 75% (N = 1439; M = 0.41, SD = 0.49).

4.3. Data analysis

To assess all the measurement instruments used in this study, confirmatory factor analyses (CFA) were computed using the lavaan package Version 0.6–9 (Rosseel, 2012) in R (RStudio Team, 2020). Fit indices of the CFA models were estimated by applying a robust maximum likelihood estimator (MLR) for the correction of data that is not normally distributed (Satorra & Bentler, 1994). Additionally, missing data was estimated with the full-information maximum likelihood (FIML) method (Arbuckle et al., 1996). Further, as the assumption of non-independence of the observations was violated, due to a complex nested data structure, we applied a survey design approach (Muthen & Satorra, 1995). In this way, unbiased estimators were calculated by introducing the cluster variable 'school.'

Our hypotheses 1 to 4 on the direct and indirect relations of teacher involvement in school improvement were tested by applying a structural equation modeling technique using Mplus Version 8.7 (Muthén & Muthen, 2017). Again, due to the nested structure of our data, we estimated the standard errors in consideration of the violation of the assumption of non-independence of observations. Applying the COMPLEX function with the cluster variable 'school' delivered unbiased parameter estimates (Muthen & Satorra, 1995). Missing values were estimated with the full information maximum likelihood method. To test significance of direct and indirect effects, confidence intervals were calculated by the bootstrap function (using 1000 bootstrap samples), as bootstrapping does not rely on the assumption of normality (Bollen & Stine, 1992).

5. Results

A confirmatory factor analysis including all the four latent constructs used in the statistical model revealed a good model fit and decent factoring structure ($\chi 2(98) = 369.89$, Yuan-Bentler correction (Mplus variant) = 1.138, $p < .001$, CFI = 0.96, TLI = 0.95; RMSEA [90% CI] = 0.053 [0.047–0.059], SRMR = 0.041). Standardized factor loadings for the latent constructs ranged from 0.60 to 0.87, indicating that each factor substantially influenced the corresponding variables. Moreover, the four composite measures, each based on four items, had acceptable internal consistency values (see Table 2 and 3). Hence, we argue that our measurement instrument was a solid ground for examining the proposed hypotheses and research questions.

5.1. Variance in teachers' involvement in school improvement

In a first step, replicating and updating findings about teachers' variance in their involvement in school improvement (i.e., Lin, 2014; Muijs & Harris, 2006; Wenner & Campbell, 2017), data analysis revealed that the teachers in the sampled schools varied substantially in their involvement (N = 1315, M = 3.61, SD = 1.05, Min = 1, Max = 6). Ranging from low to high, the participants' involvement was almost normally distributed (see Fig. 1). Intraclass coefficients (ICC1 = 0.033; ICC2 = 0.397) indicated that individuals within a school resembled each other only marginally (LeBreton & Senter, 2008) in their involvement (see Table 2). Therefore, as we outlined above theoretically, it was not primarily school-level but teacher-level factors that explained why teachers differed in their involvement in school improvement.

5.2. Correlates of leadership perception, boundary-crossing, and teacher involvement

In a second step, we examined the relationships between teacher involvement, leadership perception, and cognitive and social professional activities to further develop educational practice. Table 3 presents a correlation matrix based on the latent constructs—teacher involvement in school improvement, keeping up-to-date, brokering, and leadership perception—and the covariates.

With hypothesis 1 we proposed that there is a positive association between teacher involvement and teachers' perception of the principal's stimulation of professional development. Table 3 shows that leadership perception was positively related to the degree that teachers participated in school improvement ($r = .16$, $p < .001$). This relationship was statistically significant but weak and could not substantially explain variation in teacher involvement.

Hypothesis 2 predicted a positive relationship between teachers' cognitive boundary-crossing activities and involvement in school improvement. There was a moderate to strong association between a teacher keeping up-to-date, for instance with new scientific publications or best practice ideas for teaching, and taking an active role in changing the school's educational practice ($r = .45$, $p < .001$). Regarding the social aspect of teachers' professional activities, we predicted that brokering activity is positively related to teacher involvement (hypothesis 3). As Table 3 shows, teacher involvement was significantly and positively related to a teacher's brokering activity ($r = 0.33$, $p < .001$).

Table 3
Intercorrelations between teacher involvement in school improvement, demographic teacher variables, professional activities and leadership perception.

Variables	1	2	3	4	5
1. Teacher involvement in school's improvement	–				
Demographic teacher variables					
2. Tenure (in years)	.12**	–			
3. Percentage of full-time employment (0 = < 75%, 1 = > 75%)	.20***	-.04	–		
Professional activities					
4. Keeping up-to-date	.45***	.22***	.00	–	
5. Brokering activity	.33***	.03	.04	.32***	–
Principal's encouragement of staff development					
6. Leadership perception	.16***	.00	-.06	.14***	.16***

Note. Correlation coefficients are given at the teacher level. ***p < .001, **p < .01, *p < .05; non-significant effects in italics. Latent constructs (1, 4–6) are based on four items each rated on a 6-point Likert scale ranging from 1 (strongly disagree) to 6 (strongly agree).

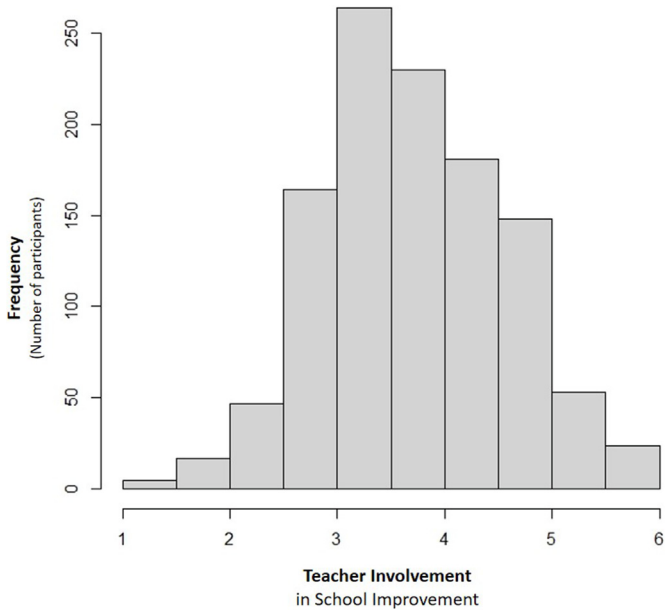

Fig. 1. Histogram of teachers' involvement in school improvement (1 = low, 6 = high involvement).

5.3. Mediating mechanisms of boundary-crossing activities

In a third and last step, we examined the mediating mechanisms of teachers' social and cognitive boundary-crossing activities on the impact of their leadership perception and their role in school improvement processes. Results for the structural equation model revealed a good model fit ($\chi^2(122) = 460.35$, Yuan-Bentler correction = 1.103, p < .001, CFI = 0.95, TLI = 0.94; RMSEA [90% CI] = 0.049 [0.045–0.054], SRMR = 0.040).

Fig. 2 shows that controlling for all factors included in our path model in terms of teacher demographics, only the percentage of full-time employment still explained differences in teacher involvement (β = 0.191, *SE* = 0.033, *p* = .000, CI = [0.127–0.256]). There was no significant direct relationship between tenure and teacher involvement (β = 0.049, *SE* = 0.033, *p* = .194, CI = [-0.034–0.093]). However, teachers' experience was associated with their keeping up-to-date activity (β = 0.217, *SE* = 0.024, *p* = .000, CI = [0.169–0.265]). Further, there were positive relationships between teachers' cognitive (β = 0.365, *SE* = 0.041, *p* = .000, CI = [0.284–0.445]) and social boundary-crossing activities (β = 0.196, *SE* = 0.036, *p* = .000, CI = [0.125–0.268]) and their involvement in changing educational practice. Moreover, both cognitive and social boundary-crossing activities were significantly and positively correlated with teachers' leadership perception. Thus, leadership perception is associated with a teacher's new knowledge-seeking (β = .136, *SE* = 0.040, *p* = .001, CI = [0.059–0.214]) and bridge-building activities (β = 0.157, *SE* = 0.036, *p* = .000, CI = [0.087–0.227]).

As there was still a significant direct relationship between leadership perception and teacher involvement (β = .088, *SE* = 0.040, *p* = .027, CI = [0.010–0.166]), we can point out that teachers' professional activities only partially mediated the relationship between a teacher's perception of the working environment and involvement in school improvement (hypotheses 4a and 4b). Leadership perception was significantly related to the teacher's participation in school improvement through boundary-crossing activities (see Table 4): for one, mediated through keeping up-to-date (β = .050, *SE* = 0.017, *p* = .003, CI = [0.017–0.082]) and for another, through brokering activities (β = 0.031, *SE* = 0.009, *p* = .000, CI = [0.014–0.048]). The total effect of the model was significant (β = 0.168, *SE* = 0.042, *p* = .000, CI = [0.086–0.251]).

6. Discussion

Teachers are crucial agents of educational change, for instance by taking an active role in shaping the school's mission, taking part in reflective dialogues about the existing educational practice, or collaborating to develop teaching activities. However, teachers' involvement in school improvement activities varies substantially between teachers. The aim of this study was to shed light on paths potentially explaining how teachers' perception of the school's leadership practice is associated with their degree of participation in school improvement. In this way, mediating mechanisms of cognitive and social aspects of boundary-crossing activities were illuminated.

Section 6.1 below discusses the key findings and the practical implications of this empirical study. Section 6.2. presents a future research agenda. Finally, section 6.3 outlines the limitations of this study.

6.1. Key contributions and practical implication

As an *introductory remark*, we want to highlight that the results of this study support previous findings on teachers varying substantially in their involvement in changing educational practice (i.e., Lin, 2014; Somech & Ron, 2007; Wenner & Campbell, 2017). A closer look at the low intra-class coefficients indicates that explanations for this variance can be found primarily on a teacher level.

Hence, as a *first contribution*, this study demonstrates that multiple teacher-level factors can explain substantially why some teachers are more involved than others in changing educational practice. The results of this study extend the existing evidence base of personal level factors impacting teacher involvement in school improvement in several ways:

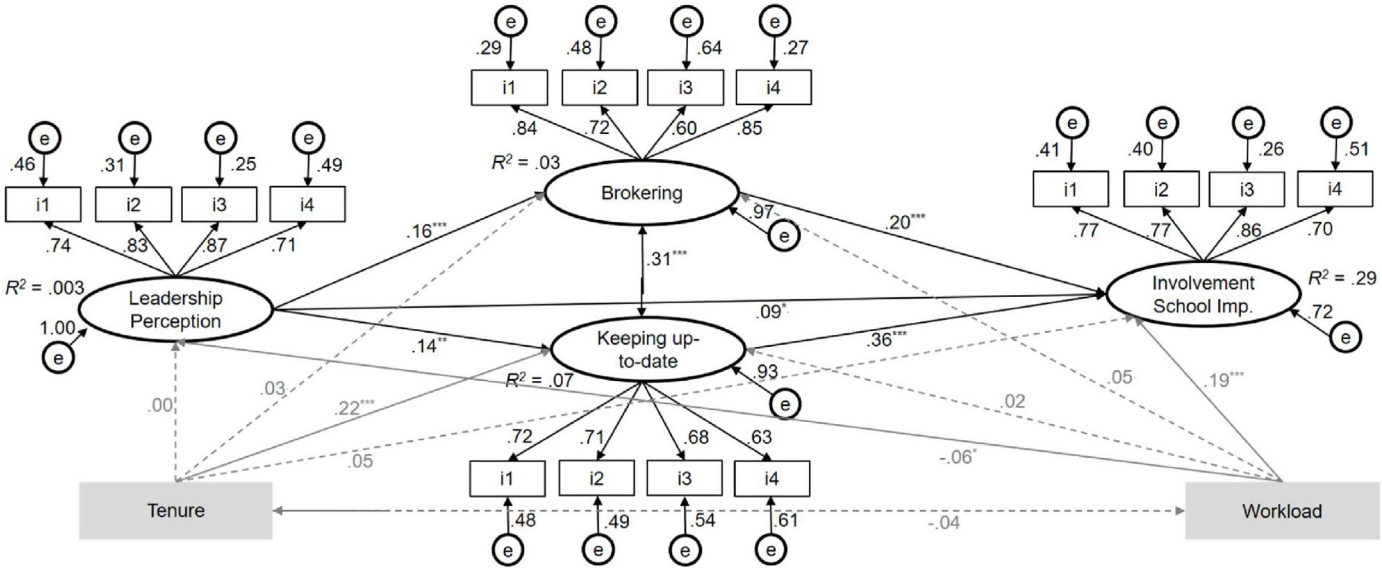

Fig. 2. Results for the multilevel structural equation model (cluster = school). $\chi^2(122) = 460.35$, Yuan-Bentler correction = 1.103, p < .001, CFI = 0.95, TLI = 0.94; RMSEA [90% CI] = 0.049 [0.045–0.054], SRMR = 0.040. e = error. * < 0.05, ** < 0.01, *** < 0.001.

Table 4
Standardized coefficients, standard errors, and confidence intervals for direct, indirect, and total effects for structural equation model.

Effects	β*(SE)*	CI_{95}	
		LL	UL
Direct effects			
Leadership perception → Involvement	.088(.040)	.010	.166
Leadership perception → Keeping up-to-date	.136(.040)	.059	.214
Leadership perception → Brokering	.157(.036)	.087	.227
Keeping up-to-date → Involvement	.365(.041)	.284	.445
Brokering → Involvement	.196(.036)	.125	.268
Indirect effects			
Leadership perception → Keeping up-to-date → Involvement	.050(.017)	.017	.082
Leadership perception → Brokering → Involvement	.031(.009)	.014	.048
Total effect	*.168(.042)*	*.086*	*.251*

Note. β = beta (standardized coefficient), *SE* = standard error, CI_{95} = 95% confidence interval, LL = lower level, UL = upper level. Confidence intervals were calculated using 1000 bootstraps.

Teachers' perception that the principal provides intellectual stimulation (hypothesis 1) is significantly related to teacher involvement—although only with a small effect size. More helpful in explaining teachers' variance in their involvement is the communities of practice framework (Wenger, 1999): Both dimensions of boundary-crossing activity are significantly and positively related to teacher involvement (hypotheses 2 and 3). Thus, our results support Obstfeld's findings (2005) on the impact of brokering activities on an individual's involvement in organizational change processes within the context of school improvement and emphasize the relevance of professional capital for involvement in school improvement processes (Hargreaves & Fullan, 2015). Hence, our study mirrors previous (mostly qualitative) research on the association between teachers' engagement in seeking new knowledge and their involvement in changing educational practice (Huizinga et al., 2014; Lin, 2014; Muijs & Harris, 2006). Moreover, based on our findings, we agree with Spillane et al. (2003) that professional capital is about both human and social capital. Hence, a comparison of the correlation coefficients between involvement and brokering activities in Obstfeld's work (0.33) and our study (0.33) revealed identical results (see also Table 3). However, there are also demographic teacher variables that explain differences in teacher involvement. In particular, teachers with a higher percentage of full-time employment participate more in the school's improvement efforts.

The *second contribution* is our finding of a possible mediating mechanism of boundary-crossing activities (hypotheses 4a and 4b) when it comes to explaining the relationship between leadership perception and teacher involvement. In this way, apart from distributed leadership (Devos et al., 2014), faculty trust (Li et al., 2016), or collective efficacy (Ross & Gray, 2006), another relevant mediating mechanism has been identified. In line with previous research, there remains a direct effect of teachers' leadership perception on teacher involvement (Devos et al., 2014; Li et al., 2016; Ross & Gray, 2006). Thus, by introducing boundary-crossing activities as mediating variables, relevant cognitive and social activities closely related to organizational change—in this case school improvement—have been identified as keys to better understanding differences in teacher involvement. Hence, teachers' boundary-crossing activities are not only essential to

understanding how teachers increase their professional capital individually but also how their perception of the school's leadership practice is related to their degree of involvement in the school's improvement efforts. Moreover, our findings indicate that it makes sense to conceptualize teachers as learners when it comes to their role in school improvement. Thus, teachers' learning is an interaction between how they perceive the environment and their actual behavior. Some researchers have conceptualized these complex interaction processes in utilization-of-learning-opportunities models for student learning (i.e., Helmke & Brühlwiler, 2018; Praetorius et al., 2018). Following these socio-constructivist frameworks and based on our findings, we argue that to better understand teachers' active involvement in school improvement, it is essential to consider how professional learning opportunities are perceived and how teachers then make use of these opportunities.

As a *practical implication*, we suggest that theoretical frameworks and empirical work on school improvement concerned with school leadership and teacher involvement benefit by integrating boundary-crossing activities as relevant concepts: Thus, teachers' seeking new knowledge and their brokering activity are two pathways through which a principal can promote teacher involvement in the school's improvement processes. In line with previous research, we argue that principals remain pivotal players in stimulating growth and shaping working conditions (Devos et al., 2014), as their role offers a variety of (formal and informal) opportunities to increase teacher involvement. In our case, principals may establish organizational structures that foster boundary-crossing activities. Ross and Gray (2006) argued that leadership research should illustrate possible and pragmatic pathways to changing educational practice effectively. Following this argumentation, boundary-crossing activities seem to be a pragmatic path where malleability and effectiveness come together.

The case is different if we look at the teacher demographics: For instance, percentage of full-time employment is strongly associated with teacher involvement. However, as desirable it might be to have as many staff members as possible with employment of more than 75%, for a principal it usually remains out of reach to alter this situation. However, future research might address the question about how to foster involvement in school improvement specifically for teachers with a lower percentage of full-time employment.

6.2. Future research

First, up to now there has been no research on how principals may alter teachers' seeking of new knowledge or their brokering activity. Therefore, from a socio-cognitive perspective future studies might examine the direct impact of principals as role models (Bandura, 2005) in crossing boundaries or analyze different strategies applied and incentives provided to increase teachers' social learning activities.

Second, teacher autonomy (Vangrieken et al., 2017) might be another interesting concept for a better understanding of variation in teacher involvement: Some teachers may worry that more involvement might curtail their autonomy, as involvement demands teachers to work more collaboratively. However, as Vangrieken and Kyndt (2020) indicated by introducing the concept of *collaborative teacher autonomy*, collaboration is by no means the counterpart of autonomy. Teachers in the role of brokers and active seekers of new pedagogical knowledge are two ways that collaborative teacher autonomy might manifest. Hence, linking the concepts of collaborative teacher autonomy (Vangrieken & Kyndt, 2020) with boundary-crossing activities in future research might be revealing.

Third, another influencing variable on teacher involvement might be teachers' beliefs: Previous research indicated that teachers' implicit theories about the malleability of professional abilities are associated with an individual's perception of both school improvement activities and outcomes (Rechsteiner et al., 2021). Thus, teachers' beliefs might also influence boundary-crossing activities and therefore teachers' involvement in school improvement.

Fourth, more research is also needed beyond the individual teacher on an organizational level (Mitchell & Sackney, 2011) to examine what features on a school or team level promote or constrain teachers' boundary-crossing activities. Analyzing teachers' involvement on a school-level, for instance, might address the issue of whether there is an optimal number or ratio of teachers taking an active part in organizational change processes, or if more is really better.

6.3. Limitations

The interpretation as to the generalization of our findings needs to be read with some caution, as we examined our theoretical model using cross-sectional data (MacKinnon et al., 2012; Maxwell et al., 2011). Therefore, it is also reasonable from a theoretical perspective to assume bidirectional relationships: For instance, more involved teachers might be more interested in seeking new knowledge or building bridges among colleagues. Taking on more responsibility in school improvement might lead to a better teacher-principal relationship, which in turn has a positive effect on teachers' leadership perception. Thus, in order to gain more insights on the mechanisms of how leadership perception, teacher involvement, and boundary-crossing activities are associated, longitudinal data or qualitative approaches are needed.

Another limitation of our study is that we did not measure the quality of teacher involvement or the quality of boundary-crossing activities. For instance, we merely analyzed whether or not someone is seeking new knowledge, acting as a broker, and ultimately, involved in school improvement. As a next step, it might be crucial to assess quality aspects of boundary-crossing activities and teacher involvement additionally—either by developing new measurement instruments for a similar quantitative approach or collecting qualitative data on these aspects.

Further, we assessed teachers' leadership perception not in terms of their individual relationship with the principal but whether the principal encourages teachers (i.e., "Our principal encourages teachers to always think about how to improve our school"). The item wording "encourages me" instead of "encourages teachers" would have been suitable for assessing an intrapersonal characteristic more than for assessing a shared construct (Stapleton et al., 2016). Therefore, it is not that surprising that teachers' perception of the school's leadership practice resulted in substantial intraclass coefficients ($ICC_1 = 0.140$; $ICC_2 = 0.759$). Hence, individuals within a school resembled each other in their perception. Nevertheless, the low intraclass coefficients in both the mediating and endogenous variables supported our theoretical argumentation supporting the conducting of structural equation modeling on a teacher level only (see Table 2). We acknowledge that in future research, more "careful attention should be paid to item wording for the measurement of constructs at specific levels" (Stapleton et al., 2016, p. 494).

One last limitation is that we relied on self-report data. Therefore, more objective information about brokering activity is missing. Future research based on a social network analysis approach might address the research question about teacher involvement and their brokerage activity based on network centrality measures—such as betweenness-centrality (Freeman,

1977)—or on analyzing presence or absence of bridging ties with structural approaches—such as exponential random graph models (Lusher et al., 2013).

7. Conclusions

Schools are supposed to be places for learning. What seems almost tautological when it comes to student learning is less obvious for teachers' professional learning. The central aim of this study was to discover why teachers differ in their involvement in school improvement. As there seems to be no school-level pattern explaining the relationship between leadership perception and teacher involvement, the question remained on a teacher level as to what professional activities in particular principals need to stimulate. We therefore analyzed teachers' learning activities at schools, conceptualized as ways to increase their professional capital—professional capital in the form of human capital, which is enhanced by searching for new knowledge, and in the form of social capital, which in our case was referred to as teachers' brokering activity. Taken together, we framed these activities based on the concept of a teacher's boundary-crossing activities. Thus, we analyzed whether boundary-crossing activities were relevant in terms of their role as mediators between teachers' leadership perception and their involvement in school improvement.

The results of this study indicate that a two-sided focus on both cognitive and social aspects of boundary-crossing activity is vital. Thus, principals (or teacher leaders) may actively promote teachers' participation in school improvement by establishing an environment where teachers regularly seek new knowledge to update their pedagogical repertoire (*knowing how*). At the same time, they may also increase social knowledge (*knowing who*), so that teachers learn to build a fabric of social agency, which is essentially about building bridges among colleagues. In this way, teachers may gradually accept more and more responsibility not only for their professional development but also for the school's improvement.

Credit author statement

Beat Rechsteiner: Conceptualization, Methodology, Formal analysis, Writing – Original draft, Writing – Review & editing, Visualization, Investigation, Data curation. **Miriam Compagnoni:** Methodology, Validation, Writing – Review & editing. **Andrea Wullschleger:** Writing – Review & editing, Investigation, Data curation, Supervision, Project administration. **Lisa Maria Schäfer:** Writing – Review & editing. **Ariane Rickenbacher:** Investigation, Data curation. **Katharina Maag Merki:** Writing – Review & editing, Investigation, Supervision, Project administration, Funding acquisition.

Declaration of competing interest

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.tate.2022.103774.

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