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RESEARCH ARTICLE

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Leading intra-organizational collaboration among public employees: a mixed methods study

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ABSTRACT

Public service delivery often necessitates collaboration among frontline employees; yet, understanding how leadership can facilitate intra-organizational collaboration remains underexplored. This study integrates theoretical insights from the educational literature on collaboration in professional learning communities into the public management field, offering a structured framework for examining how transformational leadership and professional development leadership serve as drivers of collaboration in frontline public service organizations. Using a mixed-methods approach with panel survey data complemented by interviews with managers and teachers in public schools, we find that both transformational leadership and professional development leadership enhance collaboration within professional learning communities. However, each plays a distinct role. While transformational leadership fosters a collaboration-oriented culture grounded in shared values and vision, professional development leadership strengthens shared practices through professional norms and knowledge exchange. These findings highlight the central role of shaping collaboration dynamics among frontline employees and provide a strong foundation for advancing team-based collaborative practices essential for the delivery of many public services.

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Introduction

Effective public service delivery often hinges on collaboration among frontline employees enabling access to a broader pool of resources, knowledge, and information, which can increase organizational performance (Thomson and Perry 2006; Whitford et al. 2010). Understanding and explaining collaboration among public employees is especially important considering the defining features of frontline work, such as discretion in decision-making, insecurity, and cross-pressure (Lipsky 2010; Møller and Grøn 2024). A growing public management literature therefore studies how collaboration and deliberation can provide public employees with guiding principles that reduce their insecurity and support shared responsibilities (Foldy and Buckley 2010; Harrits and Møller 2014; Møller 2021; van der Meer 2024).

Here, an important question is how leadership can support well-functioning collaboration in ways responsive to the nature of street-level work (Møller and Grøn 2024). Collaboration must be led, since it requires a supportive climate that fosters encouraging communication, trust-building, and the alignment of shared goals—key elements of successful teamwork (Lauritzen, Grøn, and Kjeldsen 2022; Thomson and Perry 2006). However, whereas drivers of inter-organizational and

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inter-sectoral collaboration have been widely studied within public administration and management (Ansell and Gash 2008; Costumato 2021), research on formal managers' leadership behaviors as drivers of intra-organizational collaboration remains limited (Campbell 2016; Thau et al. 2025; Whitford et al. 2010). This study therefore investigates how leadership can support intra-organizational collaboration among frontline employees, answering the specific research question of *whether and how transformational leadership and professional development leadership support collaboration in professional learning communities.*

We focus on two complementary types of leadership. First, we investigate *transformational leadership*, emphasizing its visionary component, which motivates employees to transcend self-interest for collective goals (Bao, Zhang, and Yang 2025; Jensen et al. 2019; van der Voet and Steijn 2021), facilitating shared perceptions and directions among employees (Jensen, Moynihan, and Salomonsen 2018; Wright, Moynihan, and Pandey 2012). This focus on collective goals and efforts makes transformational leadership particularly relevant to study as a potential driver of collaboration. Second, we investigate *professional development leadership*, which aims to align organizational goals and professional norms, develop professional knowledge among the employees, and activate their professional norms and knowledge in practice (Lund 2022a, 2024; Lund and Andersen 2023). Because of its emphasis on shared understandings of quality and more specific organizational routines for professional deliberation, we argue that this leadership behavior can be vital for successful collaboration practices among frontline public service employees. Consequently, while transformational leadership can motivate collaboration *via* visionary communication that links collaboration to the realization of organizational goals, professional development leadership can foster collaboration by facilitating specific professional standards that support collaborative efforts.

Collaboration is a process whereby two or more actors engage with each other to achieve common goals unattainable by individuals alone (Whitford et al. 2010:323). To conceptualize intra-organizational collaboration, we draw on the *professional learning communities* (PLCs) framework from educational research, in which collaboration is characterized by reflective dialogue, collective responsibility, de-privatized practice, and shared values (Christensen 2025; De Neve and Devos 2016; Stoll, Mcmahon, and Thomas 2006; Wahlstrom and Louis 2008). These components represent fundamental traits of collaboration across many public service contexts (Møller 2021; Schot, Tummers, and Noordegraaf 2020) and thus provide a systematized and pre-tested conceptualization for analyzing intra-organizational collaboration.

To study how transformational leadership and professional development leadership support collaboration in PLCs, we conduct a mixed methods study in Danish public schools consisting of two waves of teacher survey data from 2021 and 2023 (panel data with 782 observations) and 44 interviews with teachers and school managers collected as a qualitative comparative case study in eight public schools. This mixed methods study makes three primary contributions to the public management literature.

First, our study contributes to the fast-growing research field on collaboration among public employees (e.g., Schot et al. 2020; van der Meer 2024) by identifying and examining core characteristics of collaboration in public service settings. Differentiating the components of collaboration *via* an integration of the PLC framework into public management research offers a systematic foundation for future studies of collaboration across diverse frontline settings. Second, we offer empirical insight into how leadership behaviors—transformational leadership and professional development leadership—can foster collaboration. Despite significant research interest in the effects of collaboration (e.g., Campbell 2016; Burns et al. 2018; Whitford et al. 2010), we still know little about the leadership behaviors stimulating intra-organizational collaboration in public organizations. Our mixed methods design combining interviews with panel survey data allows for stronger causal inference than previous studies primarily relying on qualitative methods or cross-sectional data (Schot et al. 2020; Vangrieken et al. 2015) and explores the boundary conditions for associating leadership and collaboration (Hendren et al. 2023). Thus, the study provides good reason for viewing leadership as an essential mechanism for fostering collaboration.

Finally, while transformational leadership is broadly studied within public management (Jensen et al. 2019), we emphasize that professional development leadership also plays a distinct role in street-level bureaucratic settings, where frontline employees must balance professional norms with organizational goals. While prior studies have examined professional development leadership in healthcare, employment, and social services (Lund 2022a, 2024; Lund and Andersen 2023), education represents a particularly critical case for studying leadership and collaboration. Unlike other frontline sectors, where collaboration is more institutionally embedded, teachers traditionally work with greater autonomy and weaker formalized collaboration structures along with a tendency for resistance to leadership initiatives (Starr 2011). Education thus represents a compelling case for studying how leadership can establish and sustain collaborative professional practices, and insights from this sector may offer broader theoretical and practical implications for understanding leadership dynamics in other street-level contexts

Theoretical framework

Collaboration in professional learning communities

Public service delivery involves complex tasks that require frontline employees to balance competing interests and exercise discretion based on professional judgements. These conditions put pressure on employees and pose a risk to service quality (Møller and Grøn 2024). A growing public management literature therefore studies how intra-organizational collaboration and deliberation can provide frontline employees with guiding principles based on professional norms and knowledge, thereby reducing their insecurity in decision-making (Foldy and Buckley 2010; Harrits and Møller 2014; Møller 2021; van der Meer 2024).

In the education sector, PLCs represent an established model of collaboration, (Stoll et al. 2006; Vescio, Ross, and Adams 2008). They consist of organizational routines in which employees engage in regular reflective practices and work collectively toward a shared purpose of improved performance (DuFour and DuFour 2013; Vescio et al. 2008). According to DuFour and DuFour (2013), this conceptualization reflects several key components.[1] *Reflective practice* entails that public employees consciously interrogate their professional practices with peers, while *collective responsibility* highlights shared commitment and joint responsibility for improving outcomes (Stoll et al. 2006; Wahlstrom and Louis 2008). *De-privatizing practice* is achieved through peer observation and feedback with the intention that professional knowledge and skills are shared rather than individual (i.e., no one isolates themselves with "private practices" that are invisible and non-usable to colleagues). Finally, *shared values and vision* constitute the normative structure that governs the collaborative behavior in PLCs (De Neve and Devos 2016:363). Although there may be substantial variation in the extent to which collaborative practices are characterized by all PLC components (in terms of, e.g., whether and how often teaching experiences are observed and curriculum materials exchanged), the core objective of PLCs remains increased public service effectiveness and behaviors benefitting the end users through collaborative professional practices (Burns et al. 2018; DuFour and Fullan 2013).

Even though PLCs originate in education, public management scholars increasingly recognize collaboration as vital for organizational performance (Campbell 2016; Schot et al. 2020; van der Meer 2024; Whitford et al. 2010). However, this literature often employs broad measures of collaboration rather than disaggregating specific behavioral components. For example, Whitford et al. (2010) conceptualize collaboration as the extent to which employees generally "share job knowledge with each other" (330), and Campbell (2016) focuses on the extent to which colleagues "cooperate to get the job done" (662). Moreover, the literatures of both public management and education point to several difficulties in creating a collaborative professional culture aimed at professional development and performance (Campbell 2016; Lauritzen et al. 2022; Vangrieken et al. 2015). PLCs require a collaborative culture of mutual recognition and support among employees, including a belief that collaboration adds value to their work (Stoll et al. 2006). Hence, it is important to gain more knowledge about how organizations can address the

challenges of intra-organizational collaboration and support collaboration in, for instance, PLCs. The essence of leadership is to influence and facilitate efforts to accomplish shared objectives (Yukl 2013), and therefore, we expect leadership to be particularly important in the process of promoting collaboration.

Leadership behavior and collaboration among public employees

Leadership involves influencing others to achieve shared goals, and various leadership behaviors may foster collaboration among frontline employees. We argue that transformational leadership and professional development leadership—both previously shown to positively associate with public service performance across different contexts and conceptual operationalizations (e.g., Andersen et al. 2018a; Bao et al. 2025; Bellé 2014; Jacobsen and Andersen 2017; Liebowitz and Porter 2019; Lund and Andersen 2023; Lund 2021)—are two particularly relevant types of leadership behavior in this regard.

Transformational leadership

The distinctive theoretical aspect of transformational leadership is the manager's encouragement of employees to achieve higher-order needs for the sake of the organization. In this study, we define transformational leadership as leadership behavior with the core ambition of encouraging employees "to transcend their own self-interest and achieve organizational goals" *via* focus on the organizational vision (Jensen et al. 2019:8). In this understanding, core behaviors include developing, sharing, and sustaining a clear and compelling vision to elevate follower motivation – also beyond the immediate and tangible organizational interests (Jung and Avolio 2000), and use it continuously in communicating with employees to clarify which desirable future the organization is working to attain and how organizational members can contribute to this. When this happens, mission valence (Jensen et al. 2018; Wright et al. 2012) and employee public service motivation are stimulated (Høstrup and Andersen 2022). These mechanisms provide a fruitful foundation for a collaborative culture by nurturing shared values and collective understandings of meaningful goals among public employees (Park and Rainey 2008).

While a shared vision is broadly important for organizational performance—even in settings without daily collaboration—we argue that it becomes particularly vital when collaboration is essential for delivering complex public services. In such contexts, a compelling vision not only aligns individual efforts but also fosters the mutual commitment and coordination needed for effective teamwork. Previous research shows how both the content (Høstrup and Andersen 2022) and the communication of the vision (Jensen et al. 2018) are essential for effective transformational leadership. This is also likely to be the case if transformational leadership is deliberately used to support collaboration in PLCs. If managers exercise transformational leadership in face-to-face dialogues with the employees and the vision emphasizes collaborative aims, then this leadership behavior is likely to support professional collaboration. By clarifying the distinct value of collaboration (e.g., its contribution to student learning and its societal impact), transformational managers can enhance collective responsibility and knowledge sharing (Däniels et al. 2019; Krogsgaard et al. 2014; Wright et al. 2012), which likely sparks an increased willingness to share effective work methods and materials to improve performance instead on freeriding on others' work or keeping information to oneself.

In sum, when exerting transformational leadership, managers can foster collaboration by aligning individual motivations with collective organizational goals, reducing potential barriers that may hinder teamwork (Campbell 2018; Thomson and Perry 2006). Thereby, transformational managers are expected to change and transform organizational members to contribute to collective efforts and outcomes (Wright et al. 2012). Accordingly, we posit the following expectation:

H1: Transformational leadership supports collaboration among public employees.

Professional development leadership

Given the important role of professional judgements in public service delivery, an emerging stream of public management literature focuses on the role of leadership in facilitating high-quality and shared deliberative routines among public employees aligned with organizational objectives (Møller and Grøn 2024; Lund 2022b; Lund and Andersen 2023; Noordegraaf et al. 2016; Schott, van Kleef, and Noordegraaf 2016). While early contributions considered leadership in opposition to professional autonomy putting external pressure on professional norms, values, and discretion, more recent contributions have emphasized the integration of leadership and professionalism in contexts of public service delivery (for a discussion, see, e.g., Noordegraaf and Steijn (2013), Lund (2022a, 2025). This perspective combines organizational and professional logics and highlights how managers can activate professional norms and values to promote shared practices (De Bruijn 2010; Noordegraaf 2011; Thomas and Hewitt 2011).

Although theorized as a generic concept, more sector-specific professional development leadership behaviors targeting professional practices in health studies are labeled "medical leadership" (Noordegraaf et al. 2016) or "nursing leadership" (Cummings et al. 2008) and "teacher leadership" in education (Schott et al. 2020). Grøn, Bro, and Andersen (2020) define professional development leadership as the ability to prioritize and guide public employees toward a shared understanding of professional quality, and Lund (2022a) further specifies it as "leadership aimed at facilitating a shared understanding of professional quality within the scope of organizational goals and at influencing others to realize this understanding in practice" (Lund 2022a:517). Like transformational leadership, professional development leadership thereby seeks to influence others to accomplish shared objectives, but it places particular emphasis on activating professional norms and knowledge in employee work practices. This is important when motivating highly professionalized employees, who tend to follow professional norms and guidelines to a larger extent than managerial goals (Schott et al. 2016).

Professional development leadership comprises three core leadership practices (Lund 2022a). First, it encompasses an attempt to *align* organizational goals and professional norms by making organizational objectives professionally meaningful and develop professional norms accordingly. Second, it involves the *development* of professional knowledge, including both theoretical insight and experience-based learning. Finally, professional development leadership emphasizes *activation* of professional norms and knowledge in practice, through both planned and spontaneous efforts. Planned activation involves creating organized routines for professional deliberation, while spontaneous activation concerns ensuring that such deliberation remains grounded in professional knowledge rather than personal opinions (Lund 2022a).

Thus, the core activities of professional development leadership all focus on influencing the role of professional norms and knowledge within the organization. Since these are collective resources shared among employees from the same profession, professional development leadership entails moving from individualized private practices toward collective and shared professional practices (Lund 2022a; Møller and Grøn 2024). For example, managers' development of professional knowledge can focus on establishing collective environments where employees openly discuss mistakes as part of collective learning. Accordingly, professional development leadership is expected to foster a collaborative PLC culture in which professional practices are openly discussed and collaboration is structured around collective engagement with shared professional practices. Therefore, we expect the following:

H2: Professional development leadership supports collaboration among public employees.

Mutually reinforcing leadership behaviors?

Scholars widely recognize the significance of integrating different leadership practices (e.g., Backhaus and Vogel 2022; Crosby and Bryson 2018; Daniëls, Hondeghem, and Dochy 2019). In

addition to considering transformational and professional development leadership as separate paths to supporting professional collaboration in PLCs, it is thus highly relevant to consider how they may also interact and support each other in the promotion of collaboration among public service employees. At least, previous research shows how different leadership behaviors can complement and potentially augment each other (Marks and Printy 2003; Nielsen et al. 2019). While transformational leadership can foster an environment with good conditions for collaboration *via* shared values focusing on common interests rather than employees' individual interests, professional development leadership may boost these efforts by supporting the collaboration more concretely in the core professional activities. Conversely, professional development leadership efforts may also be more effective when supported by transformational leadership that provides strategic direction and communicates the organizational value of collaborative efforts. Moreover, transformational leadership is likely to prevent professional development leadership from being perceived as intrusive or managerial overreach as it frames collaborative professional practice within a broader purpose-driven vision. Despite these theoretical complementarities, the joint effects of transformational leadership and professional development leadership on collaboration among public employees remain unexplored. Our expectation is that these leadership behaviors complement each other by simultaneously setting direction and creating a shared sense of purpose on the one hand and facilitating more concrete professional practices on the other.

H3: The association between transformational leadership and collaboration among public employees is positively moderated by professional development leadership.

Research design and data collection: a mixed methods study

Research design and case description

To examine whether and how transformational leadership and professional development leadership support collaboration, we have conducted a mixed methods study in Danish public schools combining quantitative panel survey data with qualitative case study interviews. Specifically, the study includes survey responses from teachers in 237 schools across 20 municipalities in 2021 and 2023 and interview data from 44 school managers and teachers in eight public schools located within these municipalities. This research design enables a comprehensive and nuanced analysis of the research question enhancing both external and internal validity (Hendren et al. 2023). The quantitative analysis statistically *tests* the suggested associations between leadership and collaboration in PLCs, while the qualitative analysis provides in-depth understanding of *how* the two leadership behaviors are enacted in practice and potentially support collaboration. As the qualitative analysis is designed to refine and elaborate the statistical findings (Honig 2019), we conduct a "sequential design" combining explanatory and exploratory logics (Harrits 2011; Ivankova, Creswell, and Stick 2006; Mele and Belardinelli 2019).

The Danish school context provides a critical test of the relation between leadership and collaboration. First, the teaching profession in Denmark is historically characterized by strong professional autonomy and a high degree of resistance to management, making it a challenging environment for management influence (Starr, 2011). Moreover, teaching is often a solitary practice within classrooms with a limited tradition of collaborative practice, making efforts to increase intra-organizational collaboration particularly difficult. Thus, if management successfully enhances collaboration among teachers in this context, we have grounds to anticipate similarly positive leadership effects in other public service settings that may be less resistant to managerial influence. Second, public schools in Denmark also provide an ideal testing ground for our theory because of the expected variation in both leadership behaviors and collaboration across schools and over time. Strengthened local leadership and increased teacher collaboration were central objectives of a Danish 2014 school reform (Aftaleteksten 2013), which, while nationally initiated,

left considerable discretion to local implementation (Bjørnholt et al. 2022). Since then, no major national changes have been introduced, making our 2021–2023 data less subject to external disruptions.

Finally, Danish public schools are highly comparable in terms of professional culture, regulation, ownership, organizational structure, and funding. They are operated and funded by Denmark's 98 municipalities and include approximately 80% of Danish children aged 6–15 in mandatory education (grades 0–9) (for a comparative overview of school systems including the Danish, see Meier et al. 2015). As in most countries, teachers (frontline employees holding a BA degree in teaching) constitute the majority of staff. Thus, the organizational set-up is a constant factor in our mixed methods design. In the following, we detail the collections of quantitative survey data and qualitative interview data, beginning with the panel survey study.

Quantitative data collection and methods: Panel survey study among teachers

Data collection

The quantitative data stems from two survey waves conducted in 2021 and 2023[2] as part of a large-scale research project on collaboration in Danish public schools. All 98 municipalities were invited to participate, and 20 agreed representing considerable variation in geography, size, and socioeconomic profile of students. The municipalities provided a total of 12,884 email addresses of all categories of school staff, including the school managers in the public schools under their jurisdiction.

Response rates were approximately 20% in 2021 and 17% in 2023, corresponding to 2,218 and 1,586 teacher responses, respectively. A balanced panel of 391 teachers completed the full survey in both years (782 observations). Since the surveys cover all categories of school staff, including secretaries and school caretakers, and since some e-mail addresses were no longer in function in 2023, the calculation of response rates are approximate. Although the overall response rates are modest, population benchmarks from the Ministry of Education provide confidence in a reasonable representative sample.[3] Table 1 summarizes the teacher samples across both waves and shows almost identical distributions and means of key study variables for the surveyed teachers across the two years. This indicates that there is little variation over time regarding mean perceived PLCs, transformational leadership, and professional development leadership.

Table 1. Descriptive statistics for study variables in teacher surveys, 2021–2023.

	2021 survey ($n = 2{,}218$) % / mean (Std.)	2023 survey ($n = 1{,}586$) % / mean (Std.)	Balanced panel ($n = 391$) % / mean (Std.)
Gender			
Female	70.29 %	69.99 %	68.67 %
Male	29.71 %	30.01 %	31.33 %
Age (years)	46.13 (10.48)	47.91 (10.17)	47.74 (9.53)
Advisory role			
Yes	46.57 %	47.60 %	54.09 %
No	53.43 %	52.40 %	45.91 %
School tenure (years)	10.52 (9.18)	12.14 (8.85)	12.53 (9.21)
Investments in collaboration			
Yes	35.80 %	31.34 %	39.90 %
No	64.20 %	68.66 %	60.10 %
Professional collaboration (PLCs)	3.35 (0.73)	3.40 (0.72)	3.43 (0.73)
Reflective dialogue	4.29 (0.57)	4.29 (0.55)	4.35 (0.54)
De-privatized practice	2.91 (1.03)	2.97 (1.01)	3.03 (1.00)
Collective responsibility	3.74 (0.80)	3.76 (0.79)	3.82 (0.78)
Shared values	3.72 (0.76)	3.75 (0.74)	3.77 (0.77)
Transformational leadership	3.72 (0.91)	3.75 (0.90)	3.77 (0.93)
Professional development leadership	3.43 (0.97)	3.43 (0.96)	3.44 (0.99)

Nevertheless, within-subjects standard deviations (0.27–0.44) and between-teacher variations (0.68–0.89) suggest sufficient variation to support panel analysis.

Operationalization of study variables

To measure collaboration, we apply the Teacher's Professional Community index developed by Wahlstrom and Louis (2008), which is identified by Lomos (2012) as the preferred PLC scale because of its strong theoretical and empirical base for measuring teachers' perspectives on the PLC characteristics in schools (De Neve and Devos 2016). This scale consists of four subscales: *reflective dialogue*, *de-privatized practice*, *collective responsibility*, and *shared values and vision*. They each consist of 3–5 items asking teachers about how often they, for instance, observe each other in the classroom and provide peer feedback, talk with colleagues about curriculum materials, help each other maintain discipline across the school, and/or share a similar set of values related to teaching. These subscales are combined into a first-order reflective, second-order formative measure of PLCs capturing both the content and frequency of the collaborative practice. All survey questions and items used to measure the key variables can be seen in the online supplementary, Table A2, including confirmatory factor analyses and Cronbach's alpha measures for each of the subscales.[4] As it appears, the reliability for each of the subscales are highly acceptable, ranging from 0.74 to 0.87.

Transformational leadership is measured as teacher-perceived manager behaviors (principal or middle managers depending on school organization and size) to develop, share, and sustain a strong school vision (Jensen et al. 2019). This measure consists of four Likert scale items that have been used in other Danish school studies (Jacobsen et al. 2022; Jacobsen and Andersen 2017) and show high reliability and a good fit with our data (cf. Table A2). Professional development leadership is measured with three items reflecting teacher-perceived management practices that include the three core elements of the concept: ensuring a shared understanding of professional quality, professional development, and supporting professional reflections (Lund 2022b) (cf. Table A2). These items comprise an additive scale that shows high reliability and a good fit with our data. We use teacher-reported measures for both types of leadership since previous studies found that employee-perceived leadership is a more valid predictor of leadership behavior than the managers' own reported behavior (Jacobsen and Andersen 2015). Although transformational leadership and professional development leadership are highly correlated (cf. Table A1 in the online supplementary), their convergent and discriminant validity is supported by AVE (average variance extracted) scores (>0.5) (convergent validity) and AVE values exceeding the squared correlations between the leadership behaviors (discriminant validity). Furthermore, contrasting fit statistics from confirmatory factor analyses show that a two-factor measurement model clearly fits our data better than a one-factor model (fit statistics for a two-factor model: RMSEA = 0.056, CFI = 0.94, TLI = 0.91, SRMR = 0.03 and for a one-factor model: RMSEA = 0.116, CFI = 0.73, TLI = 0.59, SRMR = 0.08).

Estimation strategy

The availability of panel data allows for teacher fixed effects models that absorb all cross-sectional correlations and—by design—control for any potential unobserved teacher and school variables that are constant over time (Wooldridge 2015), such as the teachers' individual characteristics and personality (Dee 2005; Pedersen 2016) and school structure and culture (Gray, Mitchell, and Tarter 2014) that may influence leadership and collaboration. This also limits the risk of common source bias related to certain response tendencies inherent in measuring both the explanatory variables (leadership) and the dependent variable (collaboration) from teacher surveys (Jakobsen and Jensen 2015:22–23). However, common source bias is generally of less concern in our case given that our independent variables of interest concern teacher perceived leader behaviors, whereas the dependent variable, PLCs, taps into teacher behaviors; that is, different subjects are being evaluated.[5]

Furthermore, standard errors are clustered at the school level (*via* the school's unique institutional id number) to account for teachers being nested within schools, which likely leads to greater similarity in leadership- and PLC perceptions (Rabe-Hesketh and Skrondal 2012:167–168). The appropriateness of conducting a panel analysis (compared to, for instance, a multi-level regression analysis on pooled data) is confirmed with Breusch and Pagan's Lagrange multiplier test (p-value < 0.0001) (Rabe-Hesketh and Skrondal 2012:89), and a subsequent Hausman test for our use of fixed effects models (compared with random effects models) in the panel analysis also shows support for the appropriateness of this modeling choice in our case (p-value < 0.0001, indicating that more consistent and efficient estimators are obtained with fixed effects models) (Wooldridge 2015:288–289). We control for key time-varying factors at the individual level: teacher seniority at the school and whether the teacher holds special responsibilities, such as performing an advisory function in relation to other colleagues (e.g., reading instructor, mentor teacher, international network coordinator, etc.). Following the distribution of our sample across these characteristics (displayed in Table 1), particularly the latter mentioned control variable is important given that almost 50% of the teachers serve some special function at their school, and Table A1 in the online supplementary shows that performing such responsibilities is associated with higher perceived collaboration and may also influence their perceptions of leadership due to their close engagement with school management.

Qualitative case study: interviews among teachers and school managers

Data collection: selection of schools and interviewees

To gain deeper insight into the mechanisms linking leadership and PLCs, we conducted interviews in eight public schools located in four of the surveyed municipalities (two schools in each municipality). The selection of schools consisted of two steps aimed at maximizing variation in collaboration investments and outcomes. First, the four municipalities were selected based on school manager and teachers' reported investments in competence development regarding collaboration within the schools during the past five years (based on 2021 survey responses). Based on the share of affirmative replies grouped in municipalities, we selected two municipalities from the upper quartile of the response distribution ("high investment") and two from the lowest quartile ("low investment"). Participating in competence development aiming at improved collaboration likely improves teachers' PLCs (Grootenboer and Larkin 2019), and the investment signals an (external) priority. We therefore expect variation in PLC collaboration and contrasting contexts across the four municipalities.

Second, the eight schools—two within each municipality—were selected as most diverse cases (Seawright and Gerring 2008), that is, one school in each municipality with high investment in collaboration among the school staff and one school with low investment. Furthermore, we sought to ensure (to the widest extent possible and according to availability) that the eight schools were similar with respect to size (medium-sized schools with 400–800 students) and medium-level socioeconomic background of the students (retrieved from registers at the Ministry of Education).

At each school, individual, in-person interviews were conducted with three teachers from different grade levels (grades 0–3, 4–6, and 7–9) and their school managers (principals and one or two middle managers). In total, 44 interviews were conducted (cf. Table 2) from November 2022 to March 2023 by—in most instances—two of the authors. The interviews lasted 45–75 min and followed the ethical guidelines from the Declaration of Helsinki. Written and oral information about the study were provided to all participants, and oral informed consent was obtained. All interviews were digitally recorded, transcribed verbatim, and pseudonymized. After the collection of all interviews at a particular school, elaborated field notes were produced to preserve first-hand impressions and implicit links between interview statements regarding the leadership behaviors and the collaborative cultures and structures of the schools.

Table 2. Overview of interviewees in the qualitative data collection.

School	Municipality	Investments in collaboration (municipality/school)	Interviewees
1	A	Low/low	School principal (IP6) Middle managers (IP4, IP5, IP7) Teachers (IP1, IP2, IP3)
2	A	Low/high	School principal (IP15) Middle manager (IP16) Teachers (IP14, IP17, IP18)
3	B	High/low	School principal (IP12) Middle managers (IP8, IP11) Teachers (IP9, IP10, IP13)
4	B	High/high	School principal (IP22) Middle manager (IP23) Teachers (IP19, IP20, IP21)
5	C	High/low	School principal (IP26) Middle manager (IP27) Teachers (IP24, IP25)
6	C	High/high	School principal (IP35) Middle managers (IP33, IP34) Teachers (IP36, IP37, IP38)
7	D	Low/high	School principal (IP28) Middle managers (IP29) Teachers (IP30, IP31, IP32)
8	D	Low/low	School principal (IP44) Middle managers (IP39, IP40) Teachers (IP41, IP42, IP43)

Interview guide

The interviews were guided by a semi-structured interview guide with open-ended questions (Kvale and Brinkmann 2009). The guide was informed by our theoretical framework, addressing issues such as experiences with collaboration, competence development regarding collaboration, leadership support for collaboration, and experienced learning/teaching improvements in relation to collaboration. To ensure consistent interpretation of leadership behaviors across participants, we used visual representations of transformational leadership and professional development leadership, followed by open-ended questions asking participants to describe experienced leadership behaviors supporting collaboration. This dual approach—categorization and narrative description—helped bridge theoretical concepts with lived experience. The illustrations and their subsequent coding are inspired by Andersen et al. (2018a, 2018b).

Qualitative data analysis

The interview material was thematically coded and categorized in accordance with our theoretical framework and concepts (Gibbs 2007, 2018). Initially, a set of theoretically informed closed codes were applied. For the particular purpose of this paper, these included a) transformational leadership, b) professional development leadership, c) leadership support for collaboration, and d) intra-organizational collaboration. A preliminary coding of a subsample of interviews was discussed among the authors, and this led to the addition of some codes on, for instance, collaboration in the leadership team among school managers and more detailed definitions of other codes (see coding scheme in Table A3 in the online supplementary).

Subsequently, all interviews were coded using NVivo 12 software (QSR International, Australia), and the authors continuously discussed the coding when there were uncertainties in how to interpret the interview content to ensure intercoder reliability. All statements were condensed and compared in matrix displays matching statements of school leaders and teachers within the same school. This structures the comprehensive empirical material and improves the credibility of the analysis (Miles, Huberman, and Saldaña 2014). The results of the qualitative analysis are

presented as narrative case stories complementing the quantitative analysis in illustrating and explaining *how* leadership supports professional collaboration within schools. The case stories are developed from a combination of the coded data as well as the field notes written after each visit at a school.

Results

This section first presents the findings from the quantitative analysis testing the associations between transformational leadership, professional development leadership, and collaboration in PLCs using panel survey data with teachers and, second, the qualitative study of how teachers and school managers experience that leadership supports intra-organizational collaboration within eight schools.

Findings from the panel survey study

Table 3 shows the findings from the fixed effects panel regression analysis examining first Hypotheses 1 and 2. Models 1 and 2 confirm that increased transformational leadership and professional development leadership behaviors from school managers over time are positively associated with higher experienced teacher collaboration in PLCs in the examined schools. For instance, Model 1 shows that a one-unit increase in experienced transformational leadership

Table 3. Fixed effects panel regression analysis of professional collaboration, transformational leadership, and professional development leadership, teacher surveys 2021 and 2023.

	Dependent variable:		*Dependent variables:*							
	Professional collaboration (PLCs)		Reflective dialogue		De-privatized practice		Collective responsibility		Shared values	
	Model 1	*Model 2*	*Model 3*	*Model 4*	*Model 5*	*Model 6*	*Model 7*	*Model 8*	*Model 9*	*Model 10*
Transformational leadership	0.208***		0.166***		0.149**		0.095*		0.256***	
	(0.030)		(0.037)		(0.046)		(0.043)		(0.038)	
Professional development leadership		0.188***		0.123***		0.160***		0.085+		0.234***
		(0.033)		(0.035)		(0.047)		(0.044)		(0.036)
Seniority	−0.001	−0.001	−0.013+	−0.012+	−0.004	−0.004	0.014	0.014	−0.001	−0.001
	(0.006)	(0.006)	(0.007)	(0.007)	(0.009)	(0.009)	(0.012)	(0.012)	(0.006)	(0.007)
Advisor	−0.009	−0.065	0.068	0.028	0.077	0.033	−0.120	−0.145+	−0.055	−0.124+
	(0.073)	(0.080)	(0.068)	(0.070)	(0.123)	(0.126)	(0.085)	(0.087)	(0.066)	(0.075)
Investments in collaboration	0.042	0.038	−0.033	−0.033	0.120	0.114	0.062	0.061	−0.015	−0.020
	(0.050)	(0.050)	(0.041)	(0.041)	(0.087)	(0.086)	(0.054)	(0.054)	(0.041)	(0.040)
Year (2023)	0.048	0.030	−0.007	−0.020	0.107*	0.093*	0.009	0.001	0.044	0.022
	(0.034)	(0.032)	(0.031)	(0.030)	(0.046)	(0.045)	(0.045)	(0.044)	(0.030)	(0.030)
Constant	2.626***	2.800***	3.869***	4.089***	2.381***	2.427***	3.316***	3.398***	2.837***	3.045***
	(0.145)	(0.135)	(0.160)	(0.150)	(0.213)	(0.193)	(0.236)	(0.216)	(0.179)	(0.159)
N	782	782	782	782	782	782	782	782	782	782
R^2 (within)	0.127	0.102	0.097	0.057	0.044	0.047	0.029	0.026	0.157	0.127
R^2 (between)	0.374	0.356	0.046	0.026	0.131	0.136	0.143	0.145	0.503	0.417
R^2 (overall)	0.315	0.301	0.054	0.030	0.106	0.112	0.118	0.120	0.420	0.355
N (teachers)	391	391	391	391	391	391	391	391	391	391

Note: Clustered standard errors in parentheses (*N(schools)*=153). $^{+}p < .1$. $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Table 4. Fixed effects panel regression analysis of professional collaboration, transformational leadership, and professional development leadership (including interaction), teacher surveys 2021 and 2023.

	Dependent variable:	
	Professional collaboration (PLCs)	
	Model 1	*Model 2*
Transformational leadership (TFL)	0.153***	0.175*
	(0.036)	(0.081)
Professional development leadership (PDL)	0.101*	0.131
	(0.040)	(0.097)
Seniority	−0.002	−0.002
	(0.006)	(0.006)
Advisor	−0.032	−0.032
	(0.075)	(0.075)
Investments in collaboration	0.035	0.034
	(0.050)	(0.050)
Year (2023)	0.040	0.041
	(0.033)	(0.033)
TFL × PDL		−0.008
		(0.024)
Constant	2.512***	2.433***
	(0.148)	(0.296)
N	782	782
R^2 (within)	0.146	0.146
R^2 (between)	0.407	0.408
R^2 (overall)	0.353	0.353
N (teachers)	391	391

Note: Clustered standard errors in parentheses (*N(schools)*=153). *$p < .05$. ***$p < .001$. The interaction term between TFL and PDL is non-significant for all the four sub-dimensions of PLCs, and these models are therefore not shown (see Table A6 in the online supplementary for the full models).

from the school management is significantly associated with a 0.208 scale point increase in experienced collaboration (on a 1–5 point scale) whereas the effect size for professional development leadership is 0.188 (cf. Model 2). This indicates that both types of leadership behavior play important roles in stimulating teacher-experienced PLCs, which supports our Hypotheses 1 and 2. Alternative model specifications and estimation methods shown in Tables A4–A6 in the online supplementary testifies to the robustness of these results.

When exploring the associations between leadership and the separate dimensions of PLCs, it becomes evident that experienced transformational leadership and professional development leadership are more strongly related with an increased experience of the "shared values and vision" dimension of PLCs (cf. Models 9 and 10 in Table 3). In line with our theoretical arguments, this reflects the similar emphasis on alignment of objectives in public service delivery inherent in the conceptualization and expected impacts of both leadership behaviors.

Furthermore, the results in Table 3 suggest that transformational leadership is the more important driver of collaboration practices, characterized by reflective dialogue (cf. Model 3 with an effect size of 0.166), whereas professional development leadership to a relatively higher extent than transformational leadership stimulates more de-privatized practices such as regularly observing each other's teaching, teaching together, and providing feedback to each other among the studied teachers (cf. Model 6 with an effect size of 0.160). Conversely, neither of the examined leadership behaviors seem to be strongly related to the PLC dimension emphasizing collective responsibility for teaching and school matters (cf. Models 7 and 8), and these weak associations even become insignificant when adding additional control variables (cf. Table A5 in the online supplementary).

Turning to Hypothesis 3, the findings in Table 4 indicate that the expectation of professional development leadership to strengthen the impact of transformational leadership cannot be confirmed in the survey study—neither in relation to the composite PLC measure (cf. Model 2), nor in relation to the separate dimensions of PLCs (cf. Table A6 in the online supplementary). These unexpected results are explored further in the qualitative case study.

Findings from the qualitative case study

The case study generally corroborates the quantitative results regarding Hypotheses 1 and 2. Across the interviews, teachers describe how school managers exercise transformational leadership and professional development leadership supportive of collaboration and how. When they are not exercised, teachers also have a harder time navigating the teamwork and conflicts arise more easily (or remain unsolved). In the following, the teachers' experiences of how transformational leadership and professional development leadership support collaboration are elaborated and illustrated.

In relation to transformational leadership, particularly in Schools 2, 4, and 6, teachers highlight how the school management's clear goalsetting and articulation of a shared vision helped guide collaborative work. To illustrate, at School 2 (Box 1), the teachers describe how both the principal and the deputy principal (middle manager) communicate a clear vision and use it as a strategy to support common grounds for collaboration. However, the teachers also experience some differences in how the school manager and deputy principal exercise transformational leadership. The principal's leadership was characterized by two-way dialogue and the translation of abstract visions into concrete goals, while the deputy principal's approach was perceived as less tangible, sometimes focusing more on aspirational "dreams" than on immediate solutions. Teachers stressed that without such translation processes and inclusive dialogue, visionary leadership remained too abstract to effectively support collaboration. This difference illustrates how the teachers' experience of transformational leadership is particularly supportive for a collaborative culture when it is exercised in two-way dialogues. This is illustrated in the first quote in Box 1, where IP14 describes how the principal is aware of having the employees on board instead of just following his own direction.

Box 1. Illustration of transformational leadership supporting collaboration

At School 2, the teachers perceive notable differences between the principal and deputy principal in how they enact transformational leadership. The principal is regarded as adept at translating the school's abstract vision into concrete goals through inclusive dialogue. As IP14 describes it, "He [the principal, IP15] is good at getting us onboard. He shows the direction, but we are in on walking the talk, and he doesn't take a road where he can feel that we are not with him" (IP14). In contrast, the deputy principal's exercise of transformational leadership is experienced as less inclusive and concrete, with a stronger focus on aspirational "dreams" than on immediate problem-solving. As IP17 notes, "She [deputy principal, IP16] actually shows the direction herself … but sometimes I think, 'Can't we just do something else?'. It is not that she is doing it badly. It is because the rest of us (the employees) are more focused on solutions before we think about dream scenarios" (IP17).

By contrast, professional development leadership is considered more "hands-on" leadership, more directly tied to the teachers' professional practices, and is widely described as supportive of professional collaboration. School 3 constitutes an illustrative case of how activating professional norms and knowledge through feedback, observation, and meeting participation from the school management plays a positive role for PLCs (cf. Box 2).

Box 2. Illustration of professional development leadership supporting collaboration

At School 3, the teachers emphasize the deputy principal's close engagement with their professional practices, reflecting high levels of professional development leadership. IP13 describes how facilitating professional practices directly supports collaboration when the deputy principal organizes how teachers can share and discuss teaching plans: "Our deputy principal [IP11] is really good! She observes a lot of teaching, participates in our meetings, and talks to us. If I think something should be observed in another class, I go talk to her. I think we have a very open culture, and for instance at our last meeting in the 0–3 grades team, everyone was told to bring a teaching plan. Then we could see how different we are, although every one of us thinks that we are all doing it the same way" (IP13).

Another teacher at the school emphasizes how this proximity to professional routines strengthens the knowledge base underpinning collaboration, ensuring that it becomes "truly professional": "She [the deputy principal, IP11] is very clear that now, we put this on the agenda and makes sure that we get some knowledge and data to back it up. We help each other, and she gets into things—and if she doesn't know, she will find out (…) We help each other a lot among the teachers. We share everything—yearly plans and teaching plans and so on" (IP10).

At school 3 (see Box 2), the two teachers explain how the deputy principal closely engage with their daily professional practice. Through her presence, feedback, and agenda setting, she facilitates alignment and coordination among teachers, for instance, by prompting reflection on alternative approaches to teaching plans. She thereby highlights the complexity of teaching and fosters mutual inspiration through reflective discussions. As IP10 explains, such leadership behaviors have positive implications for the teachers' experiences of collective responsibility and openness toward de-privatizing practices. This is much in line with the quantitative findings in Table 3, which show a positive association between teacher-perceived professional development leadership and de-privatized PLC practice.

IP13 also mentions that the school management has formalized professional teamwork by initiating annual conversations with each class team of teachers in the beginning of the school year to facilitate mutual exchange of expectations: "We match our expectations in the teams in the beginning of the year. Where are we? And what do we need from each other?" These expectations are documented and forwarded to the management team as written collaboration agreements. Such formal procedures were unique to School 3; yet, comparable leadership behaviors of regular classroom observations, provision of individual and collective feedback on teaching and student/parent relations, and participating in meetings were also found to support collaboration in Schools 1, 3, 4, and 6.

While the sections above illustrate cases where employees experience their managers' exercise of transformational leadership and professional development leadership, as distinct modes of supporting collaboration, the qualitative data also reveal instances where these leadership behaviors are experienced as complementing one another (despite the insignificant interaction term in Table 4). This is particularly at School 4, (see Box 3). By contrast, at School 5, teachers mentioned an absence of both transformational leadership and professional development leadership from the school management: "We just decide the teamwork ourselves. I would like the school management to be clear on what they expect from us when we have to collaborate. When can we meet and get clear guidelines for the content of meetings. Personally, I think they do too little" (IP24).

Box 3. Illustration of complementary transformational leadership and professional development leadership

School 4 works very consistently with "project-based learning," requiring both students and teachers to collaborate across classes on particular topics. All interviewees at this school picked the transformational leader illustration to describe their principal, who clearly uses transformational leadership to foster a shared identity as "a project-based learning school." IP20 explains: "I think that [the principal, IP22] is good at recognizing our efforts and explaining the direction for the school." Several employees describe how the principal's enthusiasm about being a project-based learning school promotes their own motivation. The principal similarly emphasizes her efforts in facilitating this shared identity: "When new teachers apply at the school, they have a conversation with me, and we put up front on our webpage that we are a project-based learning school" (IP22). Still, she also stresses that the vision cannot stand alone and must be supported by structures such as mandatory Tuesday meetings. As she explains, "The important thing is how the content of the meetings become relevant in terms of all the things we keep saying: teamwork, professional learning communities, and smooth transitions. 'When does it become so important to me that I cannot do without it?'" (IP22). This point is also highlighted by the teachers at the school. Nonetheless, while the principal's transformational leadership provides overarching direction, much of the professional development leadership is exercised by the deputy principal who regularly observes classroom teaching, provides feedback, and supports collaboration by participating in the school's regular teacher meetings.

The case of School 4 illustrates how focusing on a shared identity as a project-based learning school *via* transformational leadership and sustaining this focus through, for instance, recruitment practices can strengthen teacher collaboration and, subsequently, student achievements. However, as the principal (IP22) clearly points out, sustaining a collaborative culture around the vision and aims of project-based learning also requires supportive structures and more specific facilitation of professional practices. At School 4, this is achieved through mandatory Tuesday meetings to coordinate within grades, classes, and subjects, which can be seen as an example of the *planned activation* element of professional development leadership. One of the teachers, IP21, describes that the school management also takes part in these meetings and, thereby, supports

the more *spontaneous activation*. She explains how the deputy principal plays a significant role for collaboration *via* professional development leadership by engagement in meetings, observing classes, and providing feedback. This aligns with the principal's view (Box 3) that the meetings must remain relevant and in line with the vision so that teachers perceive them as indispensable. School 4 teachers thus generally experience a joint management focus on setting the direction for the school as a project-based learning school *via* transformational leadership and supporting the realization in the everyday practices *via* professional development leadership.

By contrast, at some of the other schools (e.g., School 5), teachers stress that the management should go beyond merely scheduling collaborative time and structure the meeting content and actively participate and interfere when necessary. Without such management engagement, a fixed meeting structure (e.g., each Tuesday) risks being perceived as controlling instead of supporting the reflective dialogue and activation of professionalized practices and knowledge. These are examples of the challenges taking place if planned activation of professional development leadership is not supplemented with spontaneous activation. School 7 offers another example. Here, IP31 explains that when colleagues struggle with scheduling and structuring collaboration in teams, the management implements a uniform "one-size-fits-all" model with fixed agendas instead of "intervening and helping the teams where there is a need" (IP31).

The illustrative case from School 4 also highlights relatively different roles of school managers in supporting collaboration. Across interviews, professional development leadership is more often exerted by the deputy principal/middle managers, whereas transformational leadership behavior—if present—is associated with the principal. The interviews with the school managers indicate that this division is often unplanned but emerges naturally as principals devote significant time to upward and outward management, including municipality-school collaboration and budgetary responsibilities. Nevertheless, at Schools 2, 4 and 6, the principals seem to have found a way to balance transformational leadership and professional development leadership so that teachers perceive both leadership behaviors by the principal and the middle managers alike.

Conversely, Schools 5, 7, and 8 illustrate weaker management support for collaboration. Especially at School 8, teachers explain how the management hardly facilitates collaboration unless the team members experience disagreement or conflicts (cf. Box 4). While IP42 and IP43 agree that the managers do not directly support collaboration, IP41 is ambivalent, noting that although the manager expresses a desire for collaboration, she struggles to come up with concrete examples.

The absence of clear leadership guidance at school 8 results in predominantly ad hoc and emergent forms of collaboration (cf. Box 4). Teacher IP42 explains teachers organize collaboration themselves if they find it necessary, leading to significant variation across subjects, classes, and so on. Consequently, whether collaboration is reflective, de-privatized, and grounded in shared values and collective responsibility depends on the individual team members. Teacher IP41 describes this collaboration as more personal and "family oriented" than oriented toward professional development. In contrast, the teachers at School 7 agree that the school management prioritizes collaboration but provides no common goals or direction for its content, focusing instead on the (fixed) structures for collaboration.

Returning to Table 4, Model 2, we find no significant interaction term between transformational leadership and professional development leadership, despite the qualitative indication of

Box 4. Illustration of lacking leadership to support collaboration

At School 8, the school management only pays attention to collaboration among teachers when team conflicts arise. Despite recently expressing an intention to strengthen collaboration among teachers, there is no established tradition for collaboration. The last few years, internal conflicts, teacher turnover, and stress-related absence have limited the management's capacity to support collaboration. Teachers at School 8 are either uncertain whether managers support collaboration or believe they do not: "I think they have chosen that this should not be the focus right now. I wish there was some more structured support. We just take things 'on the fly', but sometimes it would be nice if they said that now you actually have the time to sit down together and do this" (IP42). However, the teachers agree that the school is characterized by an informal collaborative culture where teachers help each other if they face problems.

potential complementarity between the two types of leadership at Schools 2, 4, and 6. Hence, Hypothesis 3 cannot be fully supported in our mixed methods study. The absence of a significant interaction suggests that high levels of one kind of leadership may outweigh lower levels of the other. In other words, the results indicate that transformational leadership, for example, does not necessarily need to be backed up by professional development leadership to support intra-organizational collaboration. Still, the findings indicate multiple pathways to collaboration. Fixing collaboration structures alone, as at School 7, is insufficient without active leadership.

Further, the qualitative study shows that leadership behaviors supporting professional collaboration are not confined to formal leaders. Professional development leadership, in particular, was frequently exercised by teachers outside the school management who hold special responsibilities, such as certified reading and math advisors, team coordinators, and project coordinators, who played a significant role in supporting colleagues' collaboration. In the following, we relate this finding and the other identified results about the relationship between transformational leadership, professional development leadership, and collaboration to the existing public management literature and discuss their generalizability and implications.

Discussion and conclusion

Collaboration among public employees can play a crucial role in addressing some of the complex challenges of public service delivery, where frontline employees frequently face high insecurity and must balance conflicting considerations and priorities. Accordingly, an essential part of leading public employees includes the ability to facilitate structured collaboration grounded in shared values and practices. This mixed methods study in Danish public schools provides compelling evidence for the importance of leadership as a vital mechanism to foster collaboration—even among professionals who often exhibit individualistic work habits and are perceived as resistant to managerial initiatives. Differentiating between transformational leadership and professional development leadership and different dimensions of professional learning communities (PLCs), we identify three key findings.

First, the study introduces the concept of PLCs as a valuable theoretical framework for understanding and studying different dimensions of collaboration among frontline employees. Differentiating between dimensions of PLCs enables us to identify how leadership promotes distinct behavioral and attitudinal elements of collaboration. While transformational leadership is particularly useful in creating a collaboration-oriented culture characterized by shared values and reflective dialogues, professional development leadership is more strongly associated with shared practices among employees. Thus, drawing on the education literature, PLCs offer a systematic framework for distinguishing core elements of effective intra-organizational collaboration (DuFour and DuFour 2013; Stoll et al. 2006), which are often less explicitly defined in the public management literature (Campbell 2016; van der Meer 2024).

However, PLC elements such as shared values, collective responsibility, de-privatized practices, and reflective dialogue may extend beyond education. The broader public management literature emphasizes that effective collaboration necessitates similar attributes, including mutuality, communication, and shared goals (Thomson and Perry 2006). By bridging the PLC framework with public management perspectives on leadership, this study opens new avenues for applying PLC concepts to other public services, such as healthcare, policing, and social services, where professional collaboration is also critical to performance (Bronstein 2003; Carstensen, Kjeldsen, and Nielsen 2024; Patterson and Swan 2019; Schot et al. 2020). Practically, this framework can equip managers to design and assess collaborative initiatives more effectively by addressing specific challenges faced by public employees in relation to the components of collaboration represented by the PLC subdimensions.

Second, the findings demonstrate how specific leadership behaviors can support intra-organizational collaboration. Although transformational leadership has been extensively studied in public administration and management (Bao et al. 2025; Jensen et al. 2019), its role

in fostering structured collaboration among professionals has received limited attention. Consistent with prior research (e.g., Wright et al. 2012), we find that transformational leadership effectively instills shared values and a unified sense of purpose in collaborative contexts. However, it is less effective at promoting the de-privatized practices and collective responsibility essential to a collaborative culture, especially when abstract visions are not translated into tangible tasks. In contrast, professional development leadership is shown to support de-privatized and shared practices within employee collaboration.

Most previous studies focus on a single leadership approach, overlooking the potential interactions between leadership behaviors (Backhaus and Vogel 2022). While our statistical results do not confirm a significant interaction between transformational leadership and professional development leadership in supporting collaboration, our qualitative findings show that teachers experience that these leadership behaviors supplement each other. A collaborative-oriented vision and leadership facilitation. A collaborative-oriented vision and leadership facilitation of the structures for collaboration can be a fragile strategy if they stand alone; teachers experience that they must be reinforced by managers' spontaneous and continuous activation of professional norms and knowledge to cultivate a collaborative culture that supports professional development and teaching improvements. Future research could benefit from continuing to study different leadership practices in combination. Moreover, our findings underscore the practical necessity for public managers to employ and navigate multiple leadership strategies, balancing visionary leadership with concrete support for professional practices.

Finally, the study demonstrates the relevance of professional development leadership across various public organizations—a recent leadership concept in public management emphasizing managers' roles in facilitating shared practices that activate professional knowledge aligned with organizational objectives (Grøn et al. 2020; Lund 2022a, 2025). Unlike education-specific "teacher leadership," which focuses on feedback and observation to promote professional growth (Schott et al. 2016), professional development leadership offers a more generic approach to leading public service professionals (Lund 2022a). Supported by a mixed methods research design and a robust estimation, our findings provide a solid foundation for further research into the role of professional development leadership in enhancing collaborative professional practices in diverse public sector areas. To build a comprehensive understanding of how intra-organizational collaboration—and employee practices more broadly—unfold in public organizations, research must study leadership behaviors that concretely address these processes. In other words, it is essential to continue studying how public managers lead not only to motivate but also to ensure professional quality of public services. Professional development leadership provides a framework to study such leadership behaviors with sensitivity to the context of public organizations and street-level work. Importantly, the current study also illustrates that leadership supporting collaboration and professional development is exerted by a broader range of organizational members than just (top) managers. Recent contributions on distributed leadership reflect similar insights in healthcare settings (Carstensen et al. 2024; Jakobsen et al. 2023) and more broadly across public organizations—particularly when the organization's environmental complexity is high (van der Hoek and Kuipers 2024).

Although our empirical design advances public management research on intra-organizational collaboration, it has limitations. Future research should explore PLCs as a systematized approach for intra-organizational collaboration in other service domains as our findings are limited to the education sector and the teacher profession. Still, public schools represent comparable entities across countries (Meier et al. 2015), which testifies to the broader applicability of our results. The Danish education sector's focus on collaboration following the 2014 reform makes it a critical case for development of a collaborative culture. Traditionally, teachers enjoy high autonomy behind "closed classroom doors," and they are recognized subject experts. Demonstrating how leadership can increase collaboration in this context thus offers insights transferable to more inherently collaborative settings, such as social care or healthcare teams. Another limitation is the focus on a single profession, namely teachers. We encourage future studies to explore

intra-organizational collaboration in more complex cross-professional settings where the potential for conflict is likely larger. Finally, the survey measures of transformational leadership and professional development leadership are short scales for more comprehensive constructs (Lund 2024; Wright et al. 2012), which may also have affected our results.

Despite these limitations, the study advances our understanding of distinct dimensions of intra-organizational collaboration and how they are supported by two complementary leadership practices. This represents a more nuanced understanding of leadership in public organizations, offering a conceptual bridge between education-based collaboration frameworks and broader public management theory. Future research should continue to explore how leadership practices interact across contexts to foster effective intra-organizational collaboration that supports the quality of public service delivery while addressing the important features of public service professionals' street-level work.

Notes

1. The number of dimensions vary in DuFour's work. Sometimes, "data-informed practices" is included, and sometimes, "collective responsibility for teaching" and "ongoing development of professional competencies" are merged into one dimension.
2. The study is ethically approved by The Research Ethics Committee of The Danish Center for Social Science Research - VIVE (journal no. 2023/4). This institution was not established when the first part of the data collection was conducted in 2021.
3. The mean age of Danish teachers is 44.8 years (2021), and the share of female/male teachers is 69.1/30.9%, respectively (2021). The average school size in Denmark is 405 (number of students), whereas the schools in our sample on average holds 561 students. However, these numbers are not directly comparable given that a school may be comprised of more (smaller) subunits in the ministry's register data. Still, we may have a slight overrepresentation of larger schools in our sample. Finally, the average socio-economic reference point for Danish students is 7.6, and it is 7.7 in our sample. See Table A5 in the online supplementary presenting our main results from Table 3 with controls for these school and student characteristics.
4. Additional factor analysis of the PLC measure confirms that four factors with an eigenvalue above 1 can be retrieved. Furthermore, the confirmatory factor analysis indicates that a four-factor construct fits our data better than a one factor latent construct.
5. A Harman's single-factor test shows that 39.3% of the variance across the transformational leadership, professional development leadership, and PLC items can be explained by a single factor. Despite being criticized as a reliable test for the presence of common source bias (Jakobsen and Jensen 2015:18; Podsakoff et al. 2003:889), our test result limits the concern for common source bias.

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