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Preconditions of teachers' collaborative practice: New insights based on time-sampling data

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Abstract

Previous findings on the preconditions of teachers' collaboration are inconsistent. This might be related to the research methods used to assess the teachers' collaborative practice. Retrospective assessments by self-report on a relatively general level prevail. The validity of these self-reports is limited, however. In contrast, time-sampling methods have the potential to investigate collaborative practice specifically and longitudinally as a day-to-day process over time validly. But to date, no research on collaborative activities in schools based on time-sampling methods is available. In this study, we extended the current state of research by analysing the variability and preconditions of teachers' collaboration at four secondary schools over three weeks based on time-sampling data collected by a newly developed online practice log. Recorded were collaborative activities outside of teaching with a focus on administrative and organisational tasks and on school subject-specific tasks. The results revealed that teachers' collaborative activities varied significantly between weekdays, showing a linear decrease from Monday to Friday, regardless of the content of collaboration. Collaboration that focused on administrative-organisational tasks seemed to be quite stable over the weeks and was hardly influenced by teachers' individual characteristics. Instead, collaborative activities that focused on school subject-specific tasks varied significantly between weeks; moreover, they were influenced by teachers' leadership role and gender. The results indicate that rather stable routinised patterns of day-to-day collaboration over the weeks decrease the influence of teachers' individual characteristics. Hence, by collecting data that is closer to content-specific day-to-day collaborative activities, time-sampling methods can be seen as a driver for new insights.

Keywords: teacher collaboration; time-sampling method; online practice log

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1. Introduction

Collaborative activities in schools are teachers' activities that are performed with other teachers and professionals. Collaboration is assumed to be important for improving the quality of schools and student learning (Antoniou et al., 2015; Creemers & Kyriakides, 2008; Goddard & Goddard, 2007). However, research is inconsistent, and it is not clear which factors influence teachers' collaboration (Hargreaves, 2019; Vangrieken et al., 2015; Vangrieken et al., 2017). This is problematic, as to foster teachers' collaboration in schools it is important to better understand the preconditions.

One reason for this might be related to the research methods implemented to quantitatively assess teachers' collaboration. Retrospective assessment by self-report on a relatively general level prevails (Lecat et al., 2020; Vangrieken et al., 2015). Self-report assessments are less valid for identifying collaboration and its preconditions than other methods such as time-sampling, which allows investigation of collaborative practice as a day-to-day process over time (Ohly et al., 2010; Reis & Gable, 2000). Accordingly, analysing teachers' content-specific day-to-day collaborative activities might increase the understanding of collaboration.

In this study, we address this research deficit by applying time-sampling methods for the first time in research on teachers' collaboration. Based on a newly developed online tool, we analysed teachers' content-specific day-to-day collaborative activities outside of teaching over three weeks. Each day, the teachers identified their activities (e.g. reflecting upon individual lessons) and reported if they performed the task cooperatively (see section 4.2). We chose this method based on its potential for education research (Zirkel et al., 2015) and on previous studies on capturing principals' day-to-day practice (Camburn et al., 2010; Sebastian et al., 2018; Spillane & Zuberi, 2009) or teachers' day-to-day classroom practices (Adams et al., 2017; Elliott et al., 2014; Glennie et al., 2017; Kurz et al., 2014; Rowan & Correnti, 2009). Those studies support the assumption that a more differentiated view of content-specific day-to-day collaborative activities could also systematically extend previous results on teachers' collaboration. The benefit can be identified in at least two areas: First, it becomes possible to analyse the variability of teachers' practice and to learn how stable collaboration is. This increases the understanding of whether collaborative practice can be interpreted as a professional learning community's organisational routine (Sherer & Spillane, 2011; Spillane et al., 2016) that has the potential to foster student learning (Lomos et al., 2011). Second, due to the higher validity of the data, the identification of preconditions of collaborative practice is more valid. Accordingly, time-sampling methods are considered promising also regarding practical benefits, such as for optimising professional development programs.

The aim of this study was to analyse: (a) the variability of teachers' collaboration outside of teaching on school subject-specific tasks and on administrative and organisational tasks, respectively, over 15 weekdays, and (b) the preconditions of these teachers' collaborative activities, considering individual and contextual factors as well as the temporal structure of collaborative practice.

2. Collaborative activities in schools

2.1 Conceptual clarifications

Systematic literature reviews reveal a variety of concepts, such as professional learning communities (Stoll et al., 2006), teacher communities (Vangrieken et al., 2017), team learning (Decuyper et al., 2010), or teacher cooperation (Gräsel et al., 2006). Although there are some overlaps between the concepts, they vary in some important aspects. It is therefore important to clarify the concept used in this study.

First, we follow Vangrieken et al.'s (2015) definition of collaboration as an "umbrella term" (p. 23). Accordingly, collaborative activities in schools are teachers' activities that are performed with other teachers and professionals and can vary in terms of quantity and depth of interactions (Decuyper et al., 2010; Gräsel et al., 2006; Havnes, 2009; Schippers et al., 2007; Yang et al., 2018). In our study, we focus on all activities outside of teaching that were collaboratively performed regardless of the quality of the interactions. *Second*, collaboration in our study is not restricted to teachers but also includes interaction with school leaders and other professionals within and beyond the school (Mitchell & Sackney, 2011). *Third*, we focus on formal and informal settings, as professional learning is embedded in teachers' and school leaders' daily informal work (Kyndt et al., 2016; Lecat et al., 2020; Mitchell & Sackney, 2011; Van Gasse, 2019). *Fourth*, collaboration in schools is related to specific tasks. Referring to a typology by Vangrieken et al. (2013), possible tasks are management tasks, instruction, innovation and school reform or learning of teacher teams. Besides these primary tasks (James et al., 2007), to build schools as learning communities (Mitchell & Sackney, 2011), "material or practical tasks" (Vangrieken et al., 2013, p. 90) must be realised. Therefore, we analyse not only school subject-specific collaboration (primary tasks) but also collaboration on administrative and organisational tasks.

From a theoretical perspective, collaboration can be understood as a dynamic process that varies over time. It is situated in a complex and rather loosely coupled educational system (Weick, 1976) and is strongly embedded in the social context of the schools. Further, as empirical studies reveal, collaboration is influenced by multiple dimensions that are intertwined and facilitate or hinder collaboration. Accordingly, to identify preconditions of collaboration, a distinction can be made between personal, structural, group, process, and organisational characteristics (Kyndt et al., 2016; Vangrieken et al., 2015). In this study, we aim to analyse multiple preconditions of collaboration, emphasising individual and school factors. As a new approach, we extend previous research by analysing the effect of the temporal structure on collaboration in schools.

2.2. Preconditions of collaboration: previous research

2.2.1 Temporal structure of teachers' collaborative activities

There is no research available on the temporal structure of day-to-day teachers' collaboration in schools. However, there are some studies based on time-sampling or log data that investigated the variability of teachers' and school leaders' professional activities. For instance, Vannest and Parker (2010) analysed classroom time use of special education teachers over nine weeks by time-sampling methods and found that teachers varied considerably in their overall time expenditures and regarding several specific activity types. Differences in the variation over time depended significantly on activity type. However, no linear patterns of change could be identified. Similarly, Rowan and Correnti (2009) found an enormous variability of instructional practices from day to day between teachers and between schools.

Going further, Sebastian et al. (2018) shed light on how factors on the school level influenced variation in school principals' activities. Parts of the differences between school activities could be attributed to school factors, the school's performance level and size and type of school. School context factors tended to predict mostly hour-to-hour variation in principals' practice (e.g. morning or afternoon). Day of the week was important for only one predictor: whether planning occurred on a Friday. This activity was positively related to the school's achievement level.

Hence, the studies consistently found that there is substantial variability in teachers' and school leaders' activities over time (e.g. within days between hours, between days), between school staff, and partially between schools. Further, variation is dependent on type and content of activities; however, no consistent pattern of variability has been found.

2.2.2 Preconditions of teachers' collaborative activities on the individual level

Research on individual characteristics reveals no clear picture of the preconditions of teachers' collaborative practices, as previous analyses are lacking, and existing results are inconsistent. This is particularly true for gender, professional experience, working hours, and teachers' formal positions, whereas the effect of teachers' interest seems to be more consistent.

A literature review by Vangrieken et al. (2015) documented no gender-specific effects. Further, Kyndt et al. (2016) pointed to only two studies that identified gender as an antecedent of informal teacher learning. An international comparison study (Vieluf et al., 2012) and social network analyses (Moolenaar, Daly, Sleegers, et al., 2014) identified gender-specific effects only to some degree, and if effects were identified, they were not consistent. Findings on effects of teachers' age and professional experience are also inconsistent (Kyndt et al., 2016). If differences in collaborative practice were found, they were sometimes favourable to novice teachers and sometimes to experienced teachers. For instance, older teachers seem to be asked for advice more often on school subject matters, whereas younger teachers tend to be asked for advice on innovative instructional methods (Geeraerts et al., 2018). Further, Spillane et al. (2018) found that teachers with better performance development were not consulted more often by their colleagues but that they themselves asked others for advice and exchanged ideas with others more frequently.

However, formal positions, particularly school principals or teachers having a formal middle leader role, seem to affect collaborative practices (Bryant et al., 2020; Spillane & Kim, 2012; Vangrieken et al., 2015; Vangrieken et al., 2017). But a general effect is not apparent (Moolenaar, Daly, Cornelissen, et al., 2014), and the effects are dependent on the task of the collaboration (Wullschleger et al., 2019). Further, differences between part-time and full-time leaders can be identified (Spillane & Kim, 2012). This is also true for teachers. Moolenaar, Daly, Sleegers, et al. (2014) found that part-time teachers were contacted more often to discuss their own work than full-time teachers. As time is an important prerequisite of teachers' collaboration (Vangrieken et al., 2015), it is argued that full-time teachers have less time to collaborate and that part-time teachers need to compensate their absence from school by getting in touch with other teachers (Moolenaar, Daly, Cornelissen, et al., 2014). Also, Wullschleger et al. (2019) found that social networks in schools were influenced by the working hours status of the teachers, but the results differed between schools. At one school, there was a homophily-effect (full-time and part-time teachers collaborated more with other full-time or part-time-teachers, respectively), but at the other school, working hours did not influence collaborative practice.

As for teachers' interest and willingness to collaborate or previous experience in teaming, a clearer picture emerges: They seem to be decisive for teachers' collaboration (Vangrieken et al., 2015; Vangrieken et al., 2017). Accordingly, teachers' interest in getting to know what best practice is fosters collaborative knowledge seeking in school teams (Mitchell & Sackney, 2011).

More research is needed, therefore, and time-sampling methods could generate more insights into the complex individual conditions of teachers' collaboration.

2.2.3 Preconditions of teachers' collaborative activities on the context level

Besides individual characteristics, it seems that schools affect teacher collaboration, although the effects might be smaller than effects on the individual level. Camburn and Won Han (2017) found small differences between schools in teachers' reflective practice, which is corroborated by Vieluf et al. (2012) and Moolenaar, Daly, Sleegers, et al. (2014), who found that variance in collaboration within schools is greater than variance between schools. Nevertheless, school forms and school types (Richter & Pant, 2016; Steinert et al., 2008) or structural aspects of schools (Wullschleger et al., 2019) are related to the intensity of teachers' collaboration in schools. Moreover, focusing on school characteristics, Vangrieken et al. (2015) reported that various school factors, such as leader support or a school's culture that supports teaming, have an impact on teachers' collaboration. Also, several school improvement studies pointed to differences between schools in collaborative practice (Bryk et al., 2010; Hallinger & Heck, 2011; Muijs et al., 2004). Accordingly, it is important to analyse school differences in our study.

3. Research questions and hypotheses

The empirical evidence on the preconditions of collaborative practice is not coherent, and there is a lack of studies that identify the time structure of teachers' collaborative activities. As previous results on teachers' and school leaders' day-to-day activities suggest, the understanding of preconditions of teachers' collaborative activities could be significantly extended if teachers' day-to-day collaboration was analysed by time-sampling methods. Accordingly, the goal of this study is to identify the variability and preconditions of teachers' collaborative practice by capturing teachers' daily practice over three weeks considering different contents of collaboration. To reduce heterogeneity in teachers' collaborative practice, this study focuses on teachers' collaborative activities that are performed outside of teaching and investigates two research questions. Due to the inconsistency of results and the incompleteness of previous research, the hypotheses are analysed only exploratorily.

3.1 To what extent do collaborative activities outside of teaching vary over the weekdays and over the three weeks (RQ1)?

H 1a: We expect to find differences between weekdays regarding collaborative activities (Rowan & Correnti, 2009; Sebastian et al., 2018; Vannest & Parker, 2010). However, due to inconsistent patterns of variabilities between the weekdays in previous research, it is not clear whether the differences follow a linear trend over the weekdays. Differential effects in terms of content are not assumed, as in previous research the variation between days was substantial for all analysed types of activities.

H 1b: We assume effects of the week on teachers' *collaboration on school subject-specific tasks*. We argue that collaborative activities outside of teaching on school subject-specific tasks might differ due to specific demands that vary in intensity across weeks and the school year (for example, professional development training) and due to the only seldom practiced highly intensive, reflexive learning activities of teachers (e.g. Camburn & Won Han, 2017). Additionally, it is assumed that for *collaboration on administrative and organisational tasks*, schools have implemented quite stable schedules and routines that help to structure daily business (Feldman & Pentland, 2003; Sherer & Spillane, 2011). Consequently, the three weeks are not expected to differ regarding collaboration on administrative and organisational tasks.

3.2 To what extent are teachers' collaborative activities outside of teaching influenced by schools and by individual factors (RQ2)?

H 2a: In both content areas of cooperation, we expect to find differences between schools; however, the differences might be rather small (Rowan & Correnti, 2009; Sebastian et al., 2018).

H 2b: Regarding gender effects, previous research is scarce and inconsistent (Moolenaar, Daly, Sleegers, et al., 2014; Kyndt et al., 2016). This is also true for teachers' work experience at schools (Kyndt et al. 2016; Geeraerts et al., 2018; Spillane et al., 2018) and working hours (Moolenaar, Daly, Sleegers, et al., 2014; Wullschleger et al., 2019). Therefore, it is not possible to state a clear hypothesis.

H 2c: A positive effect of school leaders' positions on teachers' cooperation might be seen for cooperative activities on school-subject matters, as school leaders play important roles in building schools' improvement capacity (Mitchell & Sackney, 2011) and professional capital (Hargreaves & Fullan, 2012). However, collaboration on administrative and organisational tasks is probably influenced more by formal structures. Accordingly, we do not expect to find a higher level of daily collaboration of school leaders in schools.

H 2d: We expect to find a positive relationship between interest in searching for new knowledge and teachers' collaborative activities (Vangrieken et al., 2015; Vangrieken et al., 2017). However, we

assume that this might be particularly true for collaboration on school-subject tasks, as collaboration on administrative and organisational tasks might be regulated more by general guidelines.

4. Methodology

4.1 Sample

We investigated teachers' collaborative practice in four lower secondary schools (ISCED 2; 13- to 15-year-old students) in three cantons in the German-speaking part of Switzerland. In lower secondary schools, teachers' collaboration is mandatory. In addition, special education teachers and school social workers complement the regular teaching staff, which also makes collaborative practice necessary.

As a basis for school selection, we analysed the social context of the schools, as empirical studies have found that the social context influences school improvement processes and collaborative practice (Bryk et al., 2010; Muijs et al., 2004; Vieluf et al., 2012). It was decisive that the variance between the schools be particularly large. We included two schools in an urban area with a higher vs. lower proportion of foreigners (18.1% vs. 27.4%) (see Table 1: schools 1 and 4). In contrast, one school in a rural area was selected (school 2) with a similar proportion of foreigners as the first urban school 1 but with a higher proportion of residents with a university degree than in the first urban school (39% vs. 33%). Finally, school 3 differed from the other schools in that it was also located in a suburban area with a similar proportion of foreigners as schools 1 and 2 but with a rapidly growing community and economy in recent years and a particularly high proportion of residents with a university degree (43%). All schools participated voluntarily in this study. Of the total population of 105 teachers, 81 participated in the time-sampling study (see Table 1). The response rate of 77.1% was high and did not vary between schools ($X^2 = 1.12$, $df = 3$, $p = .77$).

Most of the teachers who did not participate in the study were on maternity leave. Women made up 56.3% of all teachers, which largely corresponds to the distribution in lower secondary schools in the German-speaking part of Switzerland. The workload per week of almost two thirds of the teachers (64.9%) was at least 80%, only 21.6% had a workload of less than 60%. The average length of service was 14.6 years ($SD = 9.2$). Moreover, many of the teachers had been working at their school for many years ($M = 10.2$, $SD = 8.2$). We did not find any significant school differences in workload or experience. Teachers having a leadership position made up 37.0% ($N = 30$) of the participants, acting as principal or middle leader. Before the time sampling started, the teachers had to fill in a questionnaire that assessed individual characteristics.

Table 1

Composition of the sample

Schools	Population teachers	Response rate time-sampling sub-study	Community residents	School context	Proportion of foreigners among the community residents[a]	Proportion of residents with tertiary education[b]
School 1	24	21 (87.5%)	20,077	Urban/ regional centre	18.1%	33.0%
School 2	23	15 (65.2%)	3,600	Rural	15.1%	39.3%
School 3	30	23 (76.7%)	8,800	Suburban	17.1%	43.4%
School 4	28	22 (78.6%)	6,400	Urban/ regional centre	27.4%	27.8%
Total	105	81 (77.1%)				

a https://www.atlas.bfs.admin.ch/maps/13/de/13559_90_89_70/21857.html [retrieved 1 April, 2021]

b https://www.bfs.admin.ch/bfs/de/home/statistiken/bildung-wissenschaft/erhebungen/sba.html [retrieved 1 April, 2021]

4.2 Methods to assess collaborative activities: time sampling

For three seven-day weeks between fall and Christmas 2017, activities were assessed using an online practice log that teachers filled in at the end of each workday (including weekend days, if work had been done) (see Figure 1). There was a week's break between each of the three daily log weeks to reduce teachers' workload, resulting in a sample of three discontinuous weeks over a five-week period. Every day at 5 p.m. teachers received a text message or e-mail with the prompt to log their activities for the day. At the end of the three weeks, we conducted interviews with teachers and the school leaders at each school. The interviews revealed that the teachers had no problems filling in their log. Initial analyses point to validity of the practice log (Maag Merki et al., 2021).

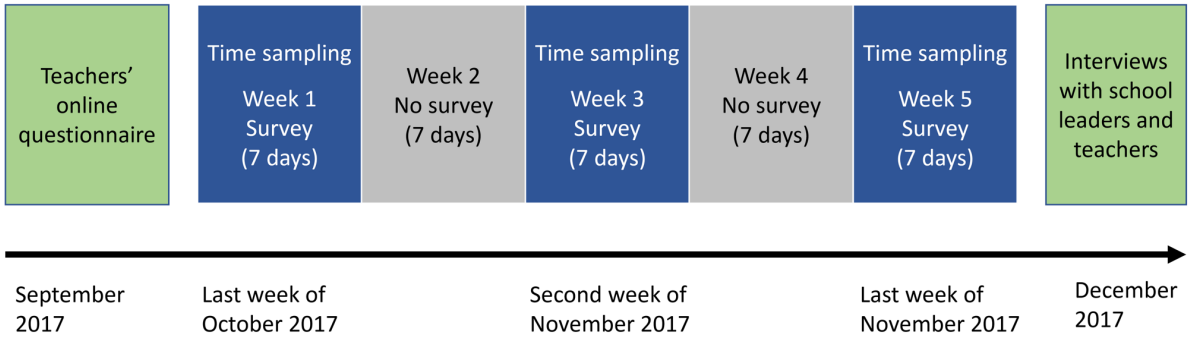

Figure 1. Research design

The online practice log was structured by the following three steps:

1. If the teachers worked on a day, they responded to the following: "You are involved in different activities in your school life. Please state for each activity which category you assign it to (e.g. teaching)". They were then asked to identify all their daily activities based on a catalogue of four main categories and 15 subcategories (multiple references were possible). The categories cover the core

responsibilities of teachers as stated in the laws. For the analyses of the research questions, only the 11 teachers' activities that took place outside of teaching (see Table 2), were included.[1]

2. The teachers were asked to indicate whether they had performed each activity by themselves or together with others. Several response categories were available for selection: e.g. alone, with the school leader, with other individual teacher(s) in the same school, with special needs teacher(s). Again, multiple references were possible.

3. After having filled in the log for all daily activities, the teachers rated whether the day had been beneficial for teaching and learning as well as for team and school improvement. Additionally, they rated their day in terms of overall stress. However, as this part of the data is not analysed here, we will not go into detail (see Maag Merki et al., 2021).

Table 2

Main categories and subcategories of the online practice log (only teachers' activities outside of teaching)

Main categories	Subcategories
Professional development and instruction	Reflecting upon and further developing individual lessons
	Exchange on school subject-specific questions
	Attending school-internal and -external professional development training
	Studying specialist literature
	Individual feedback (e.g. sitting in on classes)
	Taking part in supervision/intervision
Team improvement	Design and further development of teams/work groups
School improvement	Participating in quality management and development (e.g. evaluation, school projects, organisation development)
	Taking part in school conference meetings
	Realisation of tasks for the school
Administration and organisation	Exchange on administrative and organisational questions

4.3 Methods to assess teachers' individual characteristics

A standardised online questionnaire assessed these teachers' individual characteristics: *gender* (0 = female and 1 = male); *work experience*: How many years have you been working at schools in any kind of role?; and *workload* (% of a full time equivalent): What is your workload at this school in the current school year? (0: < 80%, 1: ≥ 80%).

Two scales investigating *teachers' interest in searching for new knowledge* (Mitchell & Sackney, 2011) were included. An *internal search interest scale* (6 items, Cronbach's alpha = .78; one-dimensional) assessed to what extent teachers had a substantial interest in learning how effective their teaching really is, e.g. "Please state what you (…) would absolutely like to know for your professional daily routine: Absolutely knowing why certain teaching practices do not work well in your own class".

An *external search interest scale* (6 items, Cronbach's alpha = .67; two-dimensional) included teachers' substantial interest in ascertaining strategies used by other teachers to successfully promote

[1] Not included in the analyses were activities such as teaching lessons, talking with students and legal guardians outside of class, or class preparation and follow-up activities such as grading, assessing the competencies of the students.

students. This scale was two-dimensional: The first dimension was interest in expert knowledge, and the second dimension was interest in the experiences of other teachers, e.g. “Please state what you (…) would absolutely like to know for your professional daily routine: Absolutely knowing how other teachers teach.”

To assess the *leadership role of the teachers,* we used comprehensive information on the leadership role of every teacher. Not only their formal leadership position but also their possible role leading institutionalized working groups at the school (e.g. teachers responsible for steering school improvement processes) were considered (0 = no leadership role, 1 = school leader or teacher with leading role regarding school development).

4.4 Data structure and final data base

To analyse the complex data structure, we relied on a five-step approach:

1. We analysed all single activities reported during 21 days to get the full picture. In total, we identified 2,642 activities, of which nearly half (44.4%, $N = 1{,}174$ activities) were performed outside of teaching. Just over half of these activities outside of teaching were performed collaboratively (52.4%, $N = 615$). On average, teachers reported $M = 14.49$ ($SD = 11.13$) activities outside of teaching over the entire data collection period. Of these, on average, $M = 7.59$ ($SD = 6.28$) activities per teacher were performed collaboratively.

2. We decided to concentrate our analyses on collaborative activities performed during the week from Monday to Friday, because we considered patterns of practice to be related mostly to weekdays. This led to a small reduction from 615 activities to 598 activities (reduction of 2.8%). Across the $N = 598$ collaborative activities from Monday to Friday, $N = 836$ aspects of a collaborative practice were addressed (see Table 3). Most often, teachers engaged in exchange on administrative and organisational tasks (in 343 collaborative activities outside of teaching; 57.4% of all collaborative activities), followed by collaboration on school subject-specific tasks (31.4%) and on the design and further development of teams/work groups (18.7%).

Table 3

Frequency of collaborative activities outside of teaching

Aspect of collaboration	Number of activities outside of teaching	% of all collaborative activities (N = 598)[a]
A. Professional development of teachers and instruction		
Reflecting upon and further developing individual lessons	49	8.2
Exchange on school subject-specific questions	188	31.4
Attending school-internal and -external professional development training	28	4.7
Studying specialist literature	3	0.5
Individual feedback (e.g. sitting in on classes)	14	2.3
Taking part in supervision/intervision	1	0.2
B. Team and school improvement		
Design and further development of teams/work groups	112	18.7
C. School improvement		
Participating in quality management and development (e.g. evaluation, school projects, organisation development)	25	4.2
Taking part in school conference meetings	34	5.7
Realisation of tasks for the school	39	6.5
D. Administration and organisation		
Exchange on administrative and organisational questions	343	57.4
Total	836	139.8[b]

[a] Total number of collaborative activities on weekdays ($N_{weekdays}$ = 15)

[b] The sum of all percentages is > 100%, as one activity can have multiple cooperative properties.

3. We concentrated our analyses on collaborative activities that focused on specific aspects only. As teachers had the possibility to address not only one aspect per activity but several (on average 1.40 aspects per activity), it was important to distinguish those activities that focused on school subject-specific tasks only (see main categories A, B, C in Table 3) or on administrative and organisational tasks only (see main category D in Table 3). As Table 4 depicts, 43.0% of all collaborative activities (n = 257) focused on school subject-specific tasks only, whereas 33.4% of all collaborative activities focused on administrative and organisational tasks only (n = 200).

Table 4

Frequency of collaborative activities outside of teaching focusing on school subject-specific tasks only, on administrative and organisational tasks only, and on both types of task simultaneously

	Number of collaborative activities	% of all collaborative activities
Collaborative activities outside of teaching that focused on school subject-specific tasks only	257	43.0%
Collaborative activities outside of teaching that focused on administrative and organisational tasks only	200	33.4%
Collaborative activities outside of teaching that focused on both school subject-specific and administrative and organisational tasks	141	23.6%
Total	598	100%

4. All collaborative activities outside of teaching (N = 598) were aggregated in a binary format on the day level (0 = activity not performed that day, 1 = activity performed that day[2]). This resulted in 417 (person-) days with any kind of collaborative activities outside of teaching (see Table 5). Of the 417 (person-) days, 115 (person-) days comprised at least one collaborative activity on administrative and organisational tasks only, 137 (person-) days comprised at least one collaborative activity on school subject-specific tasks only. In sum, 203 (person-) days (48.7%) comprised at least one collaborative activity on school subject-specific tasks only and 181 (person-) days (43.4%) comprised at least one collaborative activity on administrative and organisational tasks only. This resulted in a two-level data structure with level 1 = (person-) days nested in persons on level 2. An additional level (activities within a day) could not be considered, because the number of activities of the persons per day was too low with an average of 1.4 activities per day.

5. Finally, two dependent binary variables were calculated, one for collaborative activities outside of teaching with a focus on school subject-specific tasks only and one for collaborative activities outside of teaching with a focus on administrative and organisational tasks only. "1" means that on a day, at least one collaborative activity outside of teaching focused on school subject-specific tasks only (n = 203) and at least one collaborative activity outside of teaching focused on administrative and organisational tasks only (n = 181), respectively.

Concerning identifying the contrast (= "0"), we aimed to identify preconditions of collaborative practice outside of teaching with a specific single focus. Accordingly, as a contrast, we identified activities outside of teaching: (a) that the teachers performed collaboratively but with the contrasting focus, (b) that the teachers performed collaboratively but with a mixed focus, and (c) that the teachers performed alone. This resulted with regard to the dependent variable "collaborative activities that focused on administrative and organisational tasks only" in n = 426 (person-) days and with regard to the dependent variable "collaborative activities that focused on school subject-specific only" in n = 404 (person-) days. In total 607 (person-) days were calculated.

[2] In the context of the analysis of collaborative activities, a day record for each teacher was counted valid, if the teacher entered any type of activity outside of teaching in the daily log. For each teacher, days with entries of only teaching-related activities were excluded.

Table 5

Distribution of the (person-) days in terms of occurrence of collaborative activity outside of teaching

		(Person-) days with at least one collaborative activity outside of teaching on school subject-specific tasks only		
		0[a]	1[a]	Total
(Person-) days with at least one collaborative activity on administrative and organisational tasks only	0[a]	99	137	236 (56.6%)
	1[a]	115	66	181 (43.4%)
Total		214 (51.3%)	203 (48.7%)	417 (100%)

[a] 0 = collaborative activity outside of teaching not performed on a day, 1 = collaborative activity outside of teaching activity performed on a day

4.5 Analyses

We analysed the data by two-level generalised estimating equations (GEE) in IBM SPSS Statistics 26 with the daily activities on level 1 and teachers' characteristics on level 2. In contrast to fixed- and random-effects hierarchical models, which account for intrasubject correlation through explicit parameterization, GEE instead uses information about the nature of the intracluster dependence to recover more precise estimates of the standard errors (Ziegler, 2011). GEE was chosen over hierarchical modelling because the given data structure did not meet the sample size-related prerequisites for explicit hierarchical modelling and because of its strengths in handling binary dependent variables.

For RQ 1, to analyse the temporal structure of the two kinds of collaborative activities, GEE with a logistic link function was applied to the two binary outcome variables, with weekdays and weeks as predictors, including the interaction between weekdays and weeks. As previous studies did not show a clear picture in terms of linearity (Sebastian et al., 2018; Vannest & Parker, 2010), two models were estimated: weekdays as a linear covariate (Monday = 1 to Friday = 5) and weekdays as a categorical factor.

For RQ 2, we first examined whether there were any significant bivariate (product-moment and point-serial) correlations between the different individual characteristics and the mean percentage of (person-) days of the collaborative activities. Moreover, the bivariate correlations (point-serial and phi) correlations among the individual factors were calculated. Secondly, to consider the hierarchical data structure of the occurrence of collaborative activities nested in persons as well as multivariate dependencies among the predictor variables, again a GEE model with a logistic link function was applied to the two binary outcome variables with gender, work experience, leadership function of the teacher, and the two scales internal and external search interest as predictors on level 2. Additionally, school was included as a categorical predictor (4 levels).

5. Findings

5.1 Variation of collaborative activities over the weekdays and over the three weeks (RQ 1)

The frequency of collaborative activities that *focused on administrative and organisational tasks only* generally seemed to be highest at the beginning of each of the three weeks and to decline during the week (see Figure 2). This was supported by the GEE analyses documented in Table 6. When including the day of the week as a numerical covariate (column 1), there was a highly significant negative effect (χ^2 = 13.63, *df* = 1, p = .000, *OR* = 0.640 for week 5 and non-significant deviations thereof in the two other weeks). This indicated a continuous decline of the frequency of administrative and organisational collaborative activities over the week, irrespective of the week: The mean differences between the three weeks remained within random variation, as did the interaction between weekdays and weeks. When alternatively introducing the weekday as a categorical factor (see Table 6, column 2), the results did not change substantially. The activities still varied significantly over the days of the week, and there were no differences between the weeks and no interaction between weekday and week.

Table 6

Weekday and week effects on collaborative activities (significant effects shown in bold)

	Daily collaborative activities with focus on administrative and organisational tasks only		Daily collaborative activities with focus on school subject-specific tasks only	
	Weekdays as linear covariate (Monday = 1 to Friday = 5)	Weekdays as categorical factor	Weekdays as linear covariate (Monday = 1 to Friday = 5)	Weekdays as categorical factor
Weekdays	**χ^2 = 13.63[a] *df* = 1, p = .000**	**χ^2 = 15.33 *df* = 4, p = .004**	χ^2 = 3.80b *df* = 1, p = .051	**χ^2 = 9.99 *df* = 4, p = .041**
Week	χ^2 = 2.24, df = 2 *p* = .326	χ^2 = 0.57, *df* = 2, p = .752	**χ^2 = 8.43 *df* = 2, p = .015**	χ^2 = 0.60 *df* = 2, p = .741
Weekday*Week	χ^2 = 3.32, *df* = 2, p = .190	χ^2 = 10.58 *df* = 8, p = .227	**χ^2 = 15.44 *df* = 2, p = .000**	**χ^2 = 19.47 *df* = 8, p = .013**

[a] *OR* = 0.640 per weekday (reference: week 5).

[b] *OR* = 0.734 per weekday (reference: week 5).

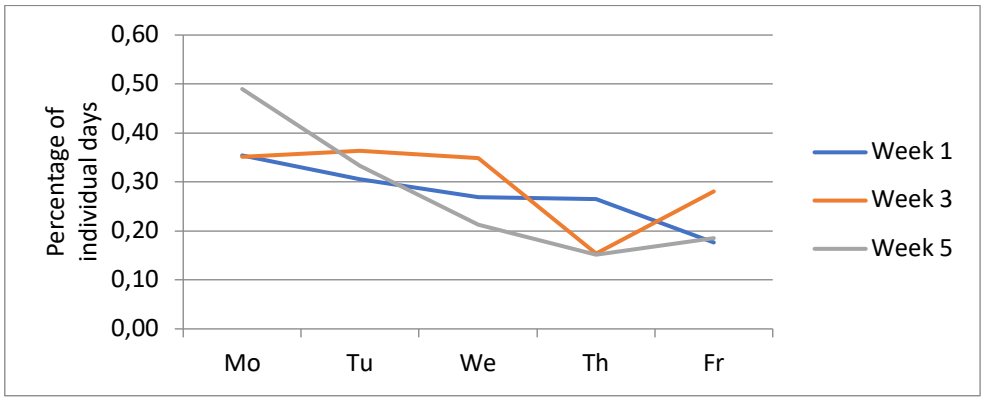

Figure 2. Percentage of (person-)days with collaborative activities that focused on administrative and organisational tasks only, by weekday and week.

The pattern looked different for the frequency of collaborative activities that *focused on school subject-specific tasks only* (see Figure 3 and Table 6, columns 3 and 4). As with the administrative and organisational collaborative activities, in weeks 3 and 5 there was a similar steady decline during the course of the week. In week 1, however, the level of school subject-specific collaborative activities was lower on Monday, and on Friday it was clearly higher.

This visual interaction between weeks and weekdays is mirrored in the quantitative analyses in Table 6, column 3. Possibly due to the diverging activity pattern of week 1, there was, by a thin margin, no significant general linear effect of the weekday. In contrast, the week made a difference, as the interaction between weekday and week was highly significant. When alternatively introducing weekday as categorical factor (Table 6, column 4), the effect of weekdays on collaborative daily activities became significant, whereas the effect of weeks was no longer significant. However, the interaction between weekdays and weeks remained significant.

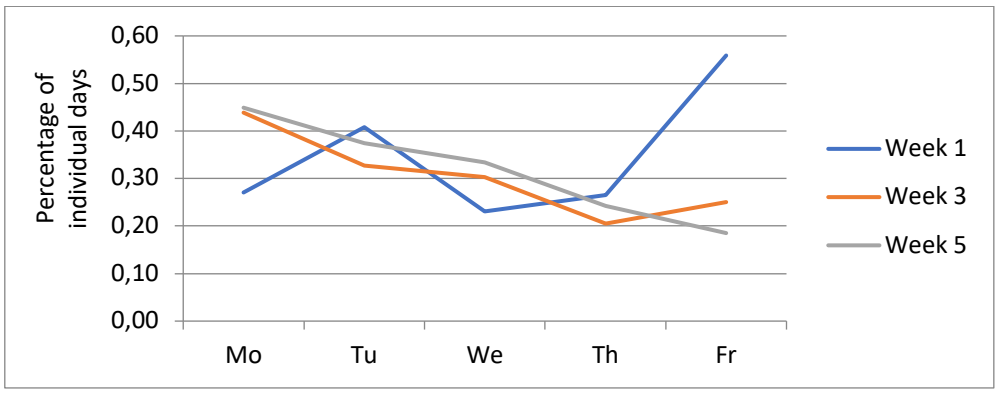

Figure 3. Percentage of (person-)days with collaborative activities that focused on school subject-specific tasks only, by weekday and week.

5.2 Preconditions of teachers' collaborative activities (RQ 2)

To assess individual and contextual preconditions, two GEE models were run. Table 7 shows the results (bivariate correlations are presented in the appendix). Regarding the reported daily frequency of collaborative activities that focused *on administrative and organisational tasks only*, there were no significant effects of the individual factors. When controlling for individual factors, the fixed effect for

schools, with four levels, did not add, overall, a significant amount to the prediction of administrative and organisational collaborative activities. However, there were two school contrasts out of a total of six that turned out to be significant ($p < .05$) when controlling for the individual factors: Teachers at school 4 had, on average, more frequent occurrences of administrative and organisational collaborative activities than teachers at school 3 (*odds ratio* = 2.31) and school 2 (*odds ratio* = 2.06).[3]

For daily occurrences of collaborative activities that focused *on school subject-specific tasks only*, two of the individual factors, gender and leadership, turned out to be predictive, with male teachers being less involved (*odds ratio* = 0.62, $p < .05$) and teachers with leadership roles being more involved (*odds ratio* = 2.18, $p < .001$) in school subject-specific collaboration. When controlling for all individual factors, there was no general school effect, but again, two school contrasts regarding the mean occurrence of subject-specific collaborative activities were significant: Teachers at school 3 showed a higher mean frequency of subject-specific collaborative activities than teachers at school 2 (*odds ratio* = 2.40, $p < .05$) and at school 4 (*odds ratio* = 1.97, $p < .05$).

Table 7

Prediction of occurrence of daily administrative and organisational and of school subject-specific collaborative activities

	Daily collaborative activities with focus on administrative and organisational tasks only	Daily collaborative activities with focus on school subject-specific tasks only
Gender (0 = f, 1 = m)	χ^2 = 0.16, *df* = 1, *p* = .692, *OR* = 0.91	**χ^2 = 4.09, *df* = 1, *p* = .043, *OR* = 0.62**
Work experience (standardised)	χ^2 = 1.59, *df* = 1, *p* = .208, *OR* = 0.83	χ^2 = 1.04, *df* = 1, *p* = .307, *OR* = 1.14
Teachers' workload (0 = <80%, 1 = ≥80%)	χ^2 = 0.03, *df* = 1, *p* = .856, *OR* = 1.06	χ^2 = 0.13, *df* = 1, *p* = .721, *OR* = 1.10
Leadership function (0 = no, 1 = yes)	χ^2 = 0.09, *df* = 1, *p* = .763, *OR* = 1.08	**χ^2 = 12.27, *df* = 1, *p* = .000, *OR* = 2.18**
Internal interest in searching for knowledge (standardised)	χ^2 = 0.19, *df* = 1, *p* = .660, *OR* = 1.09	χ^2 = 0.43, *df* = 1, *p* = .511, *OR* = 0.90
External interest in searching for knowledge (standardised)	χ^2 = 0.03, *df* = 1, *p* = .856, *OR* = 0.965	χ^2 = 1.451, *df* = 1, *p* = .228, *OR* = 1.19
School (ref. = school 4)	χ^2 = 7.70, *df* = 3, *p* = .053; **school 4 > school 3 (χ^2 = 6.06, *df* = 1, *p* = .014, *OR* = 2.31)** **school 4 > school 2 (χ^2 = 4.58, *df* = 1, *p* = .032, *OR* = 2.06)**	χ^2 = 5.82, *df* = 3, *p* = .121; **school 3 > school 2 (χ^2 = 5.03, *df* = 1, *p* = .025, *OR* = 2.40)** **school 3 > school 4 (χ^2 = 3.99, *df* = 1, *p* = .046, *OR* = 1.97)**

[3] Due to the double relative character of odds ratios (a ratio of two ratios) and their dependency on base probabilities, an interpretation in terms of (normed) effect sizes is not possible (Best & Wolf, 2012).

6. Discussion

Due to the lack of studies analysing the temporal structure of teacher collaboration and due to inconsistent results in previous research, the aim was to exploratorily analyse the variability and preconditions of teachers' collaboration outside of teaching. We implemented a newly developed online practice log over 3 weeks.

6.1 Variation of collaborative activities outside of teaching (RQ 1)

Collaborative practice outside of teaching varies significantly between the *days of the week,* regardless of the content of the collaboration. This supports previous research (Rowan & Correnti, 2009; Sebastian et al., 2018; Vannest & Parker, 2010). Further, there is a linear decrease over the weekdays from Monday to Friday for both collaboration contents, although the linearity is stronger for collaboration on administrative and organisational tasks than for collaboration on school subject-specific tasks. Teachers might start a new week by collaboratively organising the upcoming week and discussing the issues at hand. As the week proceeds, the frequency of collaboration decreases, be it due to proceeding based on a division of work, or a decrease in perceived need. Another explanation could be related to teachers' perceived autonomy (Vangrieken & Kyndt, 2020). Teachers' perceived autonomy is crucial for collaboration. It might be that to fulfil all tasks, teachers' need for autonomy is greater towards the end of the week than at the beginning of the week. Due to the different profiles of teachers' perceived autonomy need (Vangrieken & Kyndt, 2020), it would be interesting to analyse if the decrease depends on these profiles. It could be that the decline of the collaborative practice over the week in the profile 'autonomous collaborative' (which reported most collaboration), is less strong then in the other profiles. Further, it would be interesting to learn if the collaboration activities performed at the beginning of the week also qualitatively outperform those on the other days (e.g. Decuyper et al., 2010; Yang et al., 2018). If the quality also varies, it would be important not only to analyse whether the variable frequency of collaborative practice over the weekdays fits the need of fulfilling the tasks even at the end of the week but also to think about fostering the quality of collaborative practice throughout the week, for instance by external support (Gutierez, 2015; Camburn & Won Han, 2017).

As there were no *differences between weeks*, collaboration that focuses on administrative-organisational tasks only seems to be quite stable, as we expected in H1b. At best, these patterns could be interpreted as routines (Feldman & Pentland, 2003; Sherer & Spillane, 2011; Spillane et al., 2016) that help teachers deal with challenges. Routines can be interpreted as a resource for stabilizing the work. However, if the routines do not fit the requirements for successful further development of school processes, they might be barriers rather than drivers for sustainable school improvement.

In contrast, collaborative activities that focus on school subject-specific tasks only vary significantly between the weeks. This is also in line with our hypothesis H1b and indicates that this type of collaboration does not strictly follow a routinized pattern but that extraordinary events affect the modus of activities in one particular week, for instance highly intensive and reflexive learning activities (e.g. Camburn & Won Han, 2017). As Figure 3 shows, it is particularly week 1 that differs from the other weeks. Further analyses revealed that it is mainly school 1 where teachers' collaborative activities are mostly visible on Friday of the first week; on precisely that Friday a school-internal professional development training took place. Training courses in schools are not performed every week, so these activities peak every now and then.

The new insights into the variability of collaborative practice in schools have important practical implications for school improvement. They could help school leaders, as the driving force for school improvement (Bryk et al., 2010), to organise collaborative practice dependent on teachers' capacity and the content-specific need to collaborate. This targeted collaboration has potential to increase the efficiency of collaboration in professional learning communities (Stoll & Louis, 2007; Vescio et al., 2008).

6.2 Preconditions of collaborative activities outside of teaching (RQ 2)

Although in the literature many predictors were identified, in our study the collaborative activities are hardly influenced by teachers' individual or school characteristics. However, there are differential patterns of effects dependent on the area of collaboration.

In line with H2a (Sebastian et al.; 2018; Rowan & Correnti, 2009), this study reveals only weak school effects. For teachers' collaborative practice on both administrative-organisational and school subject-specific tasks, there was no overall school effect, but two significant contrasts between schools. School 4 outperformed schools 2 and 3 with a higher level of collaborative practice that focused on administrative and organisational tasks. School 4 is the school with the highest proportion of foreigners and the lowest proportion of residents with tertiary education in the community (see Table 1). We consider this socially challenging context to be relevant, as a denser coordination of administrative and organisational work could help students and parents to deal successfully with the demands of the school. For instance, in schools with a higher proportion of migrant children, teachers must coordinate on information materials more often and prepare together for meetings with the parents or with social authorities (Muijs et al., 2004). In schools with a higher proportion of children with a higher socio-economic and non-migration background, on the other hand, the parents have more knowledge about the educational system, as the cultural fit between schools and families is higher (Kramer, 2014). As a result, the need for collaboration on administrative and organisational tasks in these schools might be lower. To corroborate this hypothesis, however, it would be important to increase the size of the school sample.

Individual characteristics turn out to be more relevant for collaboration on school subject-specific than on administrative-organisational tasks. We argued in H2c and H2d that collaboration on administrative and organisational tasks might be prescribed more by school law and formal structures. Accordingly, as we did not find any significant effect of the tested individual characteristics, it seems that there is only little freedom for teachers to decide whether they want to collaborate on administrative and organisational tasks or not.

Remarkably, also teachers' interest in searching for new knowledge, internal or external, is not associated with a higher level of teachers' day-to-day collaborative activities, not even on school subject-specific tasks. This result is clearly contrary to our expectations in H2d. One explanation could be again that the legal regulations in Switzerland oblige all teachers to collaborate outside of teaching with other teachers. Accordingly, variation is rather small. Another reason might be that the rather stable pattern of day-to-day collaboration could be interpreted as a professional learning community practice with established cooperation-related norms (Sleegers et al., 2013; Stoll & Louis, 2007; Vescio et al., 2008). Also in this case, teachers' individual interests would be less influential, as schools' organisation, which is an important facilitating factor for teachers' collaboration (Vangrieken et al., 2015), largely frames teachers' activities. This result has important practical implications, as teachers differ substantially in their motivation and attitudes towards collaboration (e.g. Vangrieken & Kyndt, 2020). If collaboration belongs to the professional profile of teachers, it probably makes it easier for teachers to collaborate.

Regarding collaboration on school subject-specific tasks, we found a most significant effect of leadership function and, somewhat less pronounced, of gender. Teachers who have specific responsibilities in leading the school or a subgroup of teachers are more often involved in collaborative practices in terms of reflecting and developing the quality of schooling (see H2c). This supports those studies that found empirical evidence for school leaders to have a higher probability to be involved in discussions about work-related issues than teachers without such a role (Moolenaar, Daly, Sleegers, et al., 2014; Spillane & Kim, 2012). This result could be interpreted through the lens of professional learning communities (Sleegers et al., 2013; Stoll & Louis, 2007; Vescio et al., 2008), as they provide important routines to foster school improvement (Spillane et al., 2016). Moreover, concepts of distributed or shared leadership (Leithwood et al., 2020; Spillane & Mertz, 2015) could be a reason why school leaders are more involved in collaboration on school subject-specific tasks. The importance of

leadership for realising processes and activities in schools is also supported by theoretical models such as building learning-community capacity (Mitchell & Sackney, 2011).

Further, our results support those studies that indicate a higher frequency of collaboration by women (Vieluf et al., 2012). However, this only relates to forms of cooperation that are more freely chosen (subject-specific) and not those forms that are more regulated (administrative and organisational).

Going beyond self-reports on a general level, time-sampling data can capture not only the frequency but also the variability and stability of teacher collaboration on a daily level. As the analysed temporal structure of the collaborative activities helps to better capture the degree of variability between teachers (Ohly et al., 2010), the relevance of the analysed preconditions can be better estimated. If the results regarding the preconditions of collaboration as a routinized pattern of school improvement persist in further studies, they are most relevant for fostering teacher collaboration in schools. The most efficient way, then, would be to build professional learning communities (Sleegers et al., 2013; Stoll & Louis, 2007; Vescio et al., 2008) rather than to convince teachers to strive for more collaboration self-responsibly.

6.3. Conclusion and limitations

Taken together, our results provide evidence that the collaborative practices in both areas follow a rather standardised pattern over the days and weeks and are more strongly related to school characteristics and formal responsibilities than to teachers' individual characteristics.

Additionally, differential effects dependent on the area of collaboration are visible. Whereas schools are relevant for teachers' collaboration on administrative and organisational tasks, school leadership roles of teachers affect collaboration on school subject-specific tasks. In line with the highly different content-specific pattern of teachers' or school leaders' work (Rowan & Correnti, 2009; Sebastian et al., 2018), predictors of teachers' collaborative activities vary in terms of the content of the collaboration. However, in previous theoretical frameworks and in empirical literature reviews this result has not been sufficiently recognised up to now. It therefore seems important to consider these differential effects in the theoretical models more consistently. Further, it would be important to analyse the extent to which the different patterns of collaboration influence school development and student learning. From a learning sciences perspective, the goal of teachers' collaboration is to build human capital, to develop the quality of teaching, and finally to enhance student learning (Hargreaves & Fullan, 2012). Again, previous research is inconsistent in this regard, and a more performance-based analysis could add substantially to the existing body of research (Kyndt et al., 2016; Vangrieken et al., 2015; Vangrieken et al., 2017).

Accordingly, time-sampling methods are convincing in identifying variation in collaboration practice but also school-specific patterns of collaboration and their preconditions. For the identification of predictors for teachers' collaborative activities outside of teaching, the time-sampling method is particularly suitable, as the bias of remembering the frequency and content of the collaborative practices of teachers is much smaller, although self-reported in nature as well, than with standard questionnaires where teachers have to refer to a long period of time (Ohly et al., 2010). Nevertheless, it must be kept in mind that the results may also be influenced by the selection of the weeks: If we had chosen another week for our data collection or included more schools, the results could have been different. This is particularly true for activities that are known to be only rarely performed (e.g. Camburn & Won Han, 2017), for instance getting individual feedback by sitting in on classes (see Table 3). They could have been identified more often if we had chosen other weeks. Further, the length and positioning of the time periods examined are crucial regarding obtaining valid information on teachers' collaborative practice. Although our results are in line with previous results that show that deep-level teacher collaboration, which demands high intensity, critical discussion, and reflection or introspection, is seldom practiced (e.g. Camburn & Won Han, 2017; Muckenthaler et al., 2020; OECD, 2016), an increase in the number

of weeks might lead to a more generalisable picture of collaborative practice and could reduce idiosyncratic results. However, this is dependent on the research question and on the motivation of teachers to fill in an online practice log over a longer period (Ohly et al., 2010; Vannest & Parker, 2010). Further, it might be important to sample weeks during the whole school year and not only in the first part, as we did in this study.

Another important limitation of this study is that it was not possible to capture the quality of the collaborative activities and with whom the teachers collaborated. Theoretical models on school effectiveness and school improvement suggest that the quality is an influencing factor to explain differences between the effects of interventions (Creemers & Kyriakides, 2008). Further, the duration of the activities analysed was not specified. As we looked only at daily occurrences of activities (yes/no), activities of a very short duration and activities engaged in for a longer time were treated in the same way. Therefore, future studies should consider the duration of the activities. Additionally, we were only able to differentiate two areas of collaboration, whereas research on teachers' and school leaders' (Rowan & Correnti, 2009; Sebastian et al., 2018; Vannest & Parker, 2010) activities suggest that there is quite substantial intra-individual variation in terms of the content of activities. Therefore, our analyses could be extended by differentiating the collaboration contents further in future studies. Due to the sample size, this was not possible in this study. Accordingly, it would be fruitful to repeat this study with a much larger representative sample of schools that allows multilevel analyses. This would also be beneficial for analysing the preconditions in greater detail, considering also structural, group and process characteristics (Kyndt et al., 2016; Vangrieken et al., 2015). Finally, it is important to remember that also time-sampling data are self-reported data with some limitations, although with a reduced bias in remembering the performed activities (Glennie et al., 2017; Moeller et al., 2020; Ohly et al., 2010). Hence, this approach seems to have potential not only for analysing school leaders' and teachers' practices but also school leaders' and teachers' collaborative activities.

Keypoints

- Teachers' collaborative activities decrease linearly from Monday to Friday.
- Collaboration on administrative-organisational tasks is quite stable and varied only in dependency on the school context.
- In contrast, collaborative activities on school subject-specific tasks varied between the weeks and by teachers' school-related leadership role and gender.
- Routinised patterns of day-to-day collaboration may decrease the influence of teachers' individual characteristics.
- Time-sampling methods are a driver for new insights into the content-specific day-to-day collaboration of teachers.

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Appendix

Table X

Bivariate correlations[a] among individual factors and of individual factors with the occurrence of daily administrative and organisational and of school subject-specific collaborative activities on the person level (N = 74/81[b]) (significant effects shown in bold)

		2	3	4	5	6	Daily collaborative activities with focus on admini-strative and organisational tasks only (n = 81)	Daily collaborative activities with focus on school subject-specific tasks only (n = 81)
1	Gender (0 = f, 1 = m) (n = 74)	-.023 (.848)	.111 (.348)	.093 (.430)	.013 (.912)	.051 (.666)	-.076 (.519)	-.187 (.110)
2	Work experience (standardised) (n = 74)	--	**-.241 (.039)**	.002 (.998)	-.087 (.462)	-.078 (.508)	-0.163 (.166)	.000 (1.000)
3	Teachers' workload (0=<80%, 1=≥80%) (n = 74)		--	.011 (.926)	-.043 (.714)	-.103 (.383)	.072 (.541)	-.111 (.345)
4	Leadership function (0 = no, 1 = yes) (n = 81)			--	-.092 (.443)	-.122 (.300)	.155 (.166)	**.362 (.001)**
5	Internal interest in searching for knowledge (standardised) (n = 74)				--	**.725 (.000)**	.021 (.859)	.051 (.664)
6	External interest in searching for knowledge (standardised) (n = 74)						-.023 (.848)	-.023 (.845)

[a] Correlation coefficients are of type product-moment for two continuous variables, point-serial correlation for a continuous and a binary variable, and phi correlation for two binary variables.

[b] The valid n for the individual factors, and therefore all correlations based on these, was 74 (with the exception of leadership function); the n = 7 cases with missing values did not differ significantly from those without missings regarding the mean administrative-organisational and school subject-specific collaborative activities (both $p > .05$).