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## The relationship between teachers' evidence-based actions and communication, cooperation, and participation structures at schools

### Abstract

*In Germany, the school sector is being re-organized to feature more output orientation at schools in accordance with the new governance model (NGM), following the new public management paradigm. Newly implemented measures, such as learning standards and school inspections, are generating new evaluation data. However, school improvement can ensue only if findings from evaluations are considered in school and classroom practice. There is little research on how teachers' orientation towards and use of empirical evidence is related to the changes in school structural conditions under the NGM as seen from the teachers' perspective. In this article, we analyze how teachers' orientation towards empirical data from internal and external sources, which is considered an indicator of teachers' evidence-based actions, is related to school structures such as communication and information retrieval, internal and external cooperation, and participation. The analyses were based on a survey of 1,387 teachers from 124 schools conducted in the project Evidence-based actions within the multilevel system of schools (EviS) in the German state of Rhineland-Palatinate. We analyzed the data using structural equation models considering the nested data structure. We show that communication and information retrieval, internal and external cooperation, and participation structures explain up to 55 % of the variance of teachers' internal evidence orientation.*

### Keywords

*Teacher; Evidence-based action; School structures; Structural equation modeling*

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## **Der Zusammenhang zwischen evidenzorientiertem Handeln von Lehrkräften und Kommunikations-, Kooperations- und Partizipationsstrukturen in Schulen**

### **Zusammenfassung**

*Eine förderliche Wirkung der neuen outputorientierten Instrumente wie Bildungsstandards und Schulinspektionen, welche im Rahmen des Neuen Steuerungsmodells (NSM) implementiert wurden, kann für die Schule nur dann angenommen werden, wenn das dabei erzeugte evaluationsbasierte Wissen in der Schule handlungswirksam wird und in die Entwicklung und Realisierung unterrichtlicher und schulischer Aktivitäten einfließt. Daher ist zu untersuchen, wie Evaluationsdaten den Lehrenden zugänglich gemacht und in evidenzbasiertes Handeln überführt werden können. Die internationale Forschung liefert bisher nur wenige Befunde, welche schulischen Bestimmungsgrößen das evidenzbasierte Handeln von Lehrkräften beeinflussen können. Dies gilt insbesondere für die sich im Rahmen des NSM ändernden schulischen Strukturen. Der Artikel setzt an diesem Forschungsdefizit an und untersucht den Zusammenhang zwischen den seitens der Lehrkräfte wahrgenommenen schulischen Strukturen im Bereich der Informationsbeschaffung und Kommunikation, internen und externen Kooperation sowie Partizipation und der internen bzw. externen Evidenzorientierung als Indikator für evidenzbasiertes Handeln von Lehrkräften. Zur Analyse wird auf Daten von 1387 Lehrkräften an 124 Schulen, die im Projekt Evidenzbasiertes Handeln im schulischen Mehrebenensystem (EviS) gewonnen wurden, zurückgegriffen. Mittels Strukturgleichungsmodellierung unter Berücksichtigung der mehrebenen Datenstruktur wird gezeigt, dass Kommunikations-, Partizipations- und Kooperationsstrukturen bis zu 55 % der Varianz von interner Evidenzorientierung bei Lehrkräften erklären können.*

### **Schlagworte**

*Lehrer; Evidenzbasiertes Handeln; Schulstrukturen; Strukturgleichungsmodellierung*

## **1. Introduction**

Internationally, there is ample research on the relationship between school structures and teachers' professional orientations and actions (e.g., Ainscow et al., 2013). In Germany, an increasing number of studies have focused on the recent policy-driven quality enhancement initiatives in the school sector and their effects on schools and teaching. Previous studies have investigated which structural characteristics of schools encourage teachers to participate actively and successfully in school and classroom improvement and which structures are obstructive. This line of research has focused on how school structures influence the acceptance and im-

plementation of new techniques, methods, instruments, and course content in everyday school and classroom practice. The general assumption is that certain school structures influence teachers' actions (Böttcher, Dicke, & Ziegler, 2009; Kuper & Muslic, 2012).

This assumption is the basis for the current policy-driven reform measures implemented under the new governance model (NGM)<sup>1</sup>. The reforms are aimed at reorganizing the school system to cope effectively and efficiently with an increasingly complex set of societal and individual demands (Zlatkin-Troitschanskaia, 2006). With the implementation of the NGM in the German school sector, new structures are emerging, in particular, stronger communication, cooperation, and participation structures, such as professional project teams (e.g., Dederich, 2012). In line with the NGM, new measures are implemented, such as school inspections and large-scale assessments, generating new evaluation findings, which are becoming increasingly available to schools and teachers.

However, policy-driven, output-oriented measures can serve their purpose only if the school actors consider the newly generated findings, for example, from internal and external evaluations<sup>2</sup>, in school and classroom practice (see von der Gathen, 2006, pp. 77–80). In international research, such data-based practice is increasingly discussed under the term *data use* (Schildkamp & Lai, 2013). In the German literature, the term *teachers' evidence-based actions (evidenzbasiertes Handeln)* is used. We use the broader understanding of the term evidence-based actions from the German context (see also Stump, Zlatkin-Troitschanskaia, & Mater, 2016). Accordingly, we understand teachers' evidence-based actions as all professional behavior, decisions, and practices oriented towards improving school or classroom practices and based on relevant, available empirical findings and scientific facts. Rousseau (2006) describes this as “translating principles based on best evidence into organizational practices” (p. 256).

While research on school effectiveness has indicated that school structures have a major influence on teachers' actions in general (Ainscow et al., 2013), *there are only very limited findings on the specific relationship between school-specific*

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1 In Germany, the NGM refers to the re-organization of large parts of the public sector in accordance with the new public management paradigm. Compared to new public management in other countries, the German NGM places great emphasis on structures and structural reform. In the school sector, the NGM was tailored in response to Germany's low ranking in the Programme for International Student Assessment and has been associated in particular with greater school autonomy and the use of empirical data for teaching and administration.

2 In schools, evaluations are one source of empirical evidence. Evaluations are differentiated into the two types of internal and external evaluations depending on who directs the evaluation. External evaluations are directed by an external organization and represent an external perspective usually targeting multiple schools, such as state of learning assessments across schools. Internal evaluations are directed by the school itself and represent an internal perspective usually targeting school or classroom practice in the local context of the school itself, such as a school's evaluation of its quality mission and how well it is implemented. In the literature and in school practice, there are further distinctions of evaluations according to different perspectives and criteria (e.g., Berkemeyer & Müller, 2010, pp. 196–200).

*structural framework conditions and teachers' evidence-based actions* (for current studies in Germany, see Zlatkin-Troitschanskaia et al., 2016). This is also true for international research, which includes very few studies on the *relationship between newly implemented school structures in line with the NGM and teachers' evidence orientations as an indicator of evidence-based actions*. In this article, we address this widely discussed issue in educational policy and school practice by examining how these *newly established school structures* in crucial areas such as communication and information retrieval, internal and external cooperation, and participation structures are related to *teachers' evidence orientations*, understood as “a demand for reliable and valid information when making ... decisions” (Rousseau, 2006, p. 260). Dormann et al. (2016) following, teachers' evidence orientations are considered an indicator of teachers' evidence-based actions. We present a conceptual and empirical study offering preliminary insight into the relationship between the structures established under the NGM and teachers' evidence orientations. We highlight significant relationships in order to distinguish meaningful co-occurrence of specific school structures and specific orientations of teachers towards the use of evidence. We follow examples of studies of teacher orientations in other areas to pave the way for in-depth analyses of beneficial influence factors. Our analyses are based on data from the German interdisciplinary research project *Evidence-based actions within the multilevel system of schools – requirements, processes, and effects* (EviS) funded by German Federal Ministry of Education and Research. In the following, we describe the conceptual foundations of structural factors of communication and information retrieval, cooperation, and participation in Section 2. For a discussion on the conceptual background of evidence orientations, see Dormann et al. (2016). After giving an overview of the empirical state of research and the details of the study in Sections 3 and 4, we present the results in Section 5. We conclude with a discussion on the results and their implications for further research and school practice in Sections 6 and 7.

## **2. State of research and conceptual foundations**

### **2.1 Structural factors in schools**

#### **2.1.1 Communication and information retrieval in schools**

Communication and information retrieval play a decisive role in school improvement (Reh, 2008, pp. 163 f.). The literature distinguishes many types (e.g., Retter, 2002, pp. 13 ff.) and characteristics of communication (e.g., Watzlawick, Beavin, & Jackson, 1980, p. 50). There are various communication models and theories, for example, in information technology, action theory, and social theory (see Retter, 2002, pp. 156 ff.; Schäfers, 2003, pp. 178 f.). According to Ternes (2008), communication means “exchange of information” and therefore is “a means for obtaining knowledge and insights” (p. 20, own translation). Jung (2006) describes infor-

mation retrieval as a “systematic process of obtaining and processing information” (p. 592, own translation) forming the basis for all decisions. The definition of communication above states that communication processes include the exchange of information. According to Feldmann (2006), communication serves “mainly to convey information” (p. 281, own translation). Burkart (2002, p. 35) highlights that a medium is necessary to transfer information, and communication is a means to retrieve information. Information can be retrieved through both interpersonal communication and “technological communication” (Retter 2002, p. 14, own translation), which includes technologies such as the internet or the telephone. Thus, *we defined information retrieval as a process based on a need for information and performed through communication or the use of various media.*

Communication and information retrieval could be defined as separate theoretical constructs; however, their close relationship suggests otherwise. Both communication and information retrieval include the use of information and the use of media for information purposes. Communication functions as a key means of information retrieval. We adopted the cognitive function of communication (Bonfadelli, 2010, pp. 113 ff.), including information retrieval, because it enables information exchange as a basis for knowledge acquisition and learning (Bonfadelli, 2010, p. 119). This brief background illustrates why we considered communication and information retrieval key elements of the principles of the NGM and therefore potential correlates to teachers' evidence-based actions.

### 2.1.2 Cooperation structures in schools

Boller (2009) describes cooperation among teachers as ranging from a “momentary exchange among teachers about coordination in a single-case issue up to systematic, institutionalized cooperation” (p. 105, own translation). Since the introduction of the NGM, cooperation has been considered key for the development of schools. This has included the replacement of loosely coupled structures through forms of cooperation that enable systematic, continuous, and structured *exchange of information* as well as teamwork processes.

In the literature, there are a number of definitions of cooperation and cooperation forms in the school context (e.g., Ahlgrimm, Krey, & Huber, 2012, p. 17). According to Esslinger (2002), cooperation is understood as interaction “between two or more people ... that is initiated and performed with the aim of increasing the effectiveness of work” (p. 62, own translation). Spieß (2004) presents a definition that is widely accepted in school-related research, describing the basic preconditions for cooperation structures in schools that are essential to the construct of cooperation among teachers (e.g., Fussangel & Gräsel, 2012; Kuper & Kapelle, 2012): “Cooperation is characterized as referring to other, jointly accomplishable goals or tasks, it is intentional, communicative ..., and is bound to the norm of reciprocity” (Spieß, 2004, p. 199, own translation). Accordingly, *we defined cooperation as internal cooperation, involving interaction among several teachers inside*

*of school, or external cooperation, involving interaction between teachers and external organizations, such as other schools. Since communication and information exchange are central elements in cooperation, we assumed that cooperation, too, might be correlated with evidence-based actions.*

### **2.1.3 Participation structures in schools**

Participation is understood as the involvement of individuals and groups in organizationally relevant decision processes (Szabo, 2007, p. 5). In the literature, participation and the other structures described above are identified as key factors for the success of school improvement processes (e.g., Bonsen, 2006). Various types of teacher participation are distinguished (e.g., Staehle & Conrad, 1994, p. 269). Types of teacher participation involve teachers assuming specific leadership roles, such as those defined in leadership concepts of the school (Dubs, 2006, pp. 161 ff.; Stump et al., 2016) as well as those in executive teams of the school (Diekenbrock & Schröder, 2007, pp. 5 f.; Rahm & Schröck, 2008, pp. 46 f.). Acceptance and implementation success of school improvement projects increase considerably when teachers are involved from early on rather than being excluded from project initiation or later decision processes (Rolff, 2006, p. 299). For teachers to participate in school projects, it is essential that the school creates supportive organizational framework conditions. In line with research findings on teacher participation in school improvement processes (see Förster, 2015), *we assumed that teacher participation, for example, in regular discussions of evidences* (e.g., Diekenbrock & Schröder, 2007, p. 14), *might also be correlated with evidence-based actions.*

## **2.2 Relationship between school structures and teachers' evidence-based actions**

There are very few studies on the relationship between newly implemented school structures, in line with the NGM, and teachers' evidence-based actions. However, several studies of school improvement show that, in general, structural factors of schools influence school and classroom practice substantially. A major role is attributed to collective or social *communication, cooperation, and participation processes* among school actors. In this article, we present a more differentiated analysis of the relation between these potential structural correlates and teachers' evidence-based actions.

In Germany, several studies have been published on teachers' evidence-based actions referring to the reception and use of data from internal and external evaluations. According to Pant and Thiel (2012), teachers' use of evaluation findings in everyday practice increases if findings are discussed frequently and in depth and if principals promote such discussions. According to Dederig (2012), results of external evaluations are discussed mostly during faculty meetings and work group



meetings. Studies on evidence-based actions suggest that information retrieval plays a key role, too (Bartunek, 2007; Cummings, 2007; Guest, 2007; Latham, 2007). Breiter and Karbautzki (2012) provide an international comparison of the extent of teachers' evidence-based actions in schools. Their study includes schools in the United Kingdom, the Netherlands, Poland, Lithuania, and Germany and confirms that the availability of data, which we consider a factor of information retrieval, is correlated positively. Further studies show also a substantial influence of cooperation structures. The qualitative meta study by Wayman, Spring, Lemke, and Lehr (2012) shows that promoting cooperation among teachers is a very important and effective strategy to increase the reception and use of evaluation findings (see also Cosner, 2012). This has been confirmed by a study from the Netherlands (Schildkamp & Kuiper, 2010), in which cooperation among teachers is identified as a key positive influence. Maier, Metz, Kleinknecht, and Schymala (2012) compare two German federal states with regard to the reception and use of external findings during faculty meetings and subject teacher meetings, while controlling teacher cooperation on the interpersonal and school level. Their results show that teacher cooperation positively influences the reception and use of evaluation findings in subject teacher meetings. Further studies indicate that the impact of internal and external evaluation measures depends substantially on teacher participation. School evaluations have a greater impact when all teachers are equally responsible for analyzing the evaluation data (see, e.g., Zlatkin-Troitschanskaia & Förster, 2009; Saunders & Rudd, 1999). If we consider evidence-based actions a specific kind of innovative actions at schools, we find further evidence in innovation research that participation structures have a positive influence on innovation. For the school sector, several studies have confirmed that teacher participation in decision making has a positive influence on innovativeness within the faculty (e.g., Altrichter & Wiesinger, 2005).

Findings on school and teaching quality confirm these results, but also demonstrate that communication and information retrieval, cooperation, and participation structures on the interpersonal and school level are very complex and heterogeneous and correlate and interact with one another (e.g., Halbheer & Kunz, 2011; Fussangel & Gräsel, 2012). Effective cooperation is considered to depend on communication as a necessary condition (Boller, 2009), but cooperation does not automatically follow from communication (Schütt, 2009; Spieß, 2004). Cooperation requires a certain degree of freedom of choice and action (Spieß, 2004, p. 199). Thus, cooperation among teachers depends on participation structures within the school (Fussangel & Gräsel, 2012). These include effective communication structures and regular exchange of information in different cooperation settings. Thus, school development that focuses on participation of teachers (e.g., Dubs, 2009, p. 505) requires a high level of information exchange and communication among teachers (Grunder, 2004).



### 3. Hypotheses

Overall, recent research emphasizes the key role of school structures, in particular, communication and information retrieval, cooperation, and participation structures on teachers' actions. Specifically with regard to teachers' evidence orientation as an indicator of evidence-based actions, we assumed that the newly implemented school structures would have a positive impact on teachers' evidence orientation. In line with the theoretical and empirical state of research, we generated the following four hypotheses on the relationship between the perceived school structures and teachers' evidence orientation.

- Hypothesis 1: The more developed communication and information retrieval structures are according to teachers, the higher the teachers' evidence orientation.
- Hypothesis 2: The more developed internal cooperation structures are according to teachers, the higher the teachers' evidence orientation.
- Hypothesis 3: The more developed external cooperation structures are according to teachers, the higher the teachers' evidence orientation.
- Hypothesis 4: The more developed participation structures are according to teachers, the higher the teachers' evidence orientation.

### 4. Study design, sample and instruments

To test the hypotheses, we analyzed empirical data from the EviS project. The data was gathered from various types of schools in the federal state of Rhineland-Palatinate, Germany, from 2011 to 2012. The total sample from the project included responses of 2,640 teachers and 297 school principals from 153 schools of different school types and sizes (for distribution information, see Table A1; see also Dormann et al., 2016).

Due to practical reasons, such as limited testing time, two questionnaire versions were used to survey the teachers. Our findings were based on one version of the teacher questionnaire that surveyed teachers' perceptions of school structures and their evidence orientation. The subsample included data from 1,410 teachers from 124 schools. The percentage of missing values was only 4 % for the analyzed items. Given the low percentage of missing values, we used multivariate single imputation.<sup>3</sup> However, we excluded 15 cases in which less than 50 % of the items

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3 According to Schendera (2007, p. 120) and Graham, Cumsille, Elek-Fisk, Schinka, and Velicer (2003, p. 90), a percentage of missing values below 5 % justifies even case-wise deletion or univariate imputation, such as mean imputation. We used multivariate single imputation, which should provide better estimates than these two acceptable methods.

had been answered<sup>4</sup> as well as eight cases in which the teachers had not indicated their school affiliation. Hence, the following analyses were based on the responses of 1,387 subjects from 124 schools.

Teachers were administered a paper-pencil survey containing rating items on a five-point Likert scale from 1 (*I do not agree at all*) to 5 (*I totally agree*). The survey assessed the teachers' perceptions of school structures using scales of Stumm, Mohr, and Dormann (2010), which had been adapted to the school context. A sample item for communication and information retrieval (COMM) is "At our school, we have access to the internet and the intranet to retrieve information on current job-related developments." Since we assumed there might be differences in structures for internal and external cooperation, we selected a scale that reflected the two types of cooperation (see Section 2). A sample item for internal cooperation (COOPINT) is "At our school, we form quality groups/teacher networks to improve the quality of our work." A sample item for external cooperation (COOPEXT) is "At our school, there is support for cooperation with other schools, companies or universities." A sample item for participation (PART) is "At our school, the teachers have a say in decisions that affect their work." (for further information, see Table A2).

For the assessment of the dependent variable, we used the two sub-scales External Evidence Orientation and Internal Evidence Orientation from the scale Evidence-based Actions by Stumm et al. (2010). The dimension external evidence orientation (EE) refers to scientific or systematic data sources, while the dimension internal evidence orientation (IE) refers to findings generated by the school itself, for example, through internal evaluations. An example item for external evidence orientation is "When making important decisions at our school, we often take into account expert reports." An example for internal evidence orientation is "Before adopting procedures from other schools, we analyze their effectivity." For further information, see Table A2.

## 5. Methods and results

For the analyzed sub-sample, we tested factorial validity of all latent variables in a confirmatory factor analysis (CFA) using the software MPlus 6.0. The fit criteria showed a moderate to good model fit (see Table 1; Hu & Bentler, 1999; Weiber & Mühlhaus, 2010, p. 170).

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4 In these cases, it would have been necessary to estimate more than 50 % of the responses, which would have resulted in a too great disproportion between the available information and the number of values to be estimated for each subject. For these cases, the estimation error with single imputation would have been too large.

Table 1: Fit statistics of CFA with all latent variables

Model	RMSEA	CFI	SRMR
Confirmatory factor model with all latent variables	.050	.933	.042

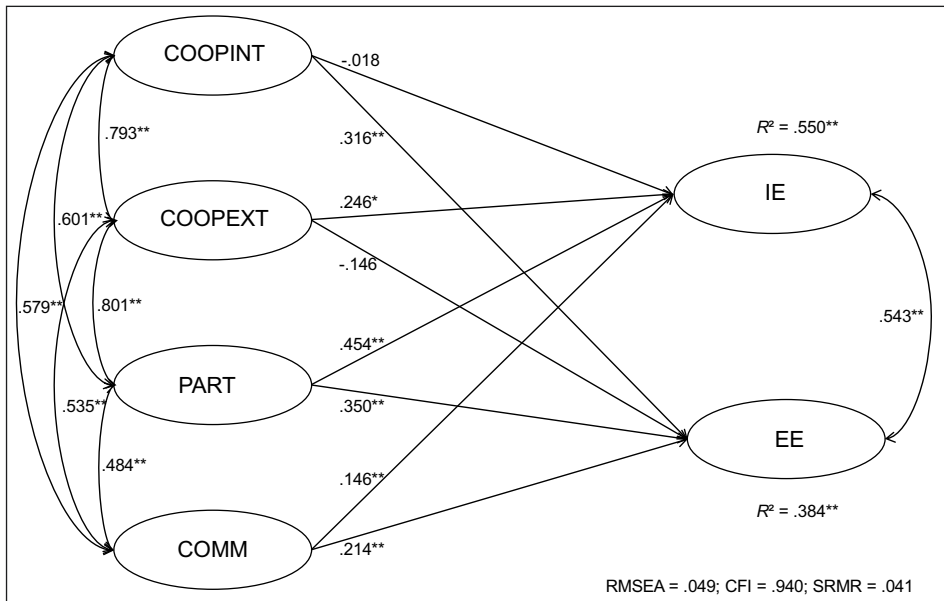
Note. RMSEA = Root Mean Square Error of Approximation; CFI = Comparative Fit Index; SRMR = Standardized Root Mean Square Residual.

Overall, the fit criteria indicated a moderate fit of the data to the theoretical model for this subsample. To evaluate the internal consistency of the scales, we calculated composite reliability (Hildebrandt & Temme, 2006, p. 13; see also Table A2). Composite reliability for COMM, COOPINT, COOPEXT, and PART was .69, .79, .75, and .84, respectively. For the analyzed subsample, composite reliability for EE and IE was .85 and .88, respectively. Thus, the reliability of all scales was above the recommended cut-off value of .6 (Bagozzi & Yi, 1988).

In our data structure, teachers were nested in schools. To investigate the relation between perceived school structures and teachers' evidence orientation on the individual and school level, we generated a multilevel structural equation model (MSEM) based on the CFA model above. However, the model was already very complex in the simple structural equation model (SEM) and the sample on the school level was rather small ( $N = 124$ ) in relation to the number of parameters to be estimated; this is why we could not estimate the entire MSEM for the same relation hypotheses on the individual and school levels. Thus, we had to decide whether to maintain the latent nature of the variables throughout the SEM or whether to focus on the multilevel structure and base the calculations on estimated factor scores, which would reflect only indirectly the latent structure. Since, we were interested mainly in the individual perception of structures of the teachers rather than in the actual differing structures of the schools themselves, we focused on the individual level (see Section 3). Therefore, we used SEM that allowed estimating complex structural relations among latent variables to account for measurement error and also enabled estimations of the correlations among determinants. To account for the nested data structure, we used the analysis type *Type = Complex* in MPlus. This way, we took into account statistical bias due to the nested sample design by adjusting standard errors and goodness-of-fit model testing (Muthén & Satorra, 1995). Estimations were conducted using maximum likelihood estimation with robust standard errors.

The results are shown in Figure 1 (for the correlation matrix of all latent variables, see Table A3; for more details on the SEM, see also Table A4). The analyses indicated that the structural variables explained approximately 55 % of IE and approximately 38 % of EE.

Figure 1: Structural equation model: Standardized regression, correlation coefficients, and percentage of variance explained of the dependent variables



Note.  $N = 1,387$ .  
\*  $p < .05$ , \*\*  $p < .01$ .

## 6. Interpretation of findings

Communication and information retrieval had a comparably small significant positive correlation to IE ( $\beta = .146$ ;  $SE = 0.037$ ) and EE ( $\beta = .214$ ;  $SE = 0.039$ ). Thus, Hypothesis 1 was confirmed. Teachers who perceived communication and information retrieval structures as being well-developed showed also a higher internal and external evidence orientation. It would make sense that teachers' evidence orientation would be considerably higher at schools that facilitated access to specialized literature, scientific databases, and other external sources of information that are difficult for teachers to obtain.

Internal cooperation structures had a comparably larger correlation to EE ( $\beta = .316$ ;  $SE = 0.075$ ), but no significant correlation to IE ( $\beta = -.018$ ;  $SE = 0.071$ ). Thus, Hypothesis 2 was confirmed for external evidence orientation. For external cooperation structures, there was no significant correlation to EE ( $\beta = -.146$ ;  $SE = 0.110$ ) and a comparably low positive correlation to IE ( $\beta = .246$ ;  $SE = 0.103$ ). Thus, Hypothesis 3 was confirmed for internal evidence orientation. Accordingly, the perception of developed cooperation structures was related to teachers' evidence orientation, but internal and external cooperation structures were related to a different extent. Cooperation structures within schools, such as team meetings, were rather related to teachers' external evidence orientation. An explana-

tion might be that schools provided more opportunities for discussions and team meetings in the context of compulsory external evaluations, such as school inspections or large-scale assessments. Cooperation structures enabling the cooperation with other schools were rather related to internal evidence orientation. Internal evidence orientation refers to findings from the local school context, which can be considered particularly relevant in cooperation and exchange of experiences between schools.

Participation structures had a comparably larger correlation to EE ( $\beta = .350$ ;  $SE = 0.068$ ) and a particularly stronger correlation to IE ( $\beta = .454$ ;  $SE = 0.068$ ). Thus, Hypothesis 4 was confirmed. Teachers who perceived opportunities for participation as being well-developed showed also a higher evidence orientation. An explanation might be that teachers who were involved in projects from early on, for example, in gathering data for an internal or external evaluation, were also more familiar with the internal and external data.

The analyses confirmed a correlation between the structural factors (see Figure 1, Section 3). Thus, teachers who had the opportunity to retrieve information for their work often also had the opportunity to cooperate with others and to participate in school improvement. We found a particularly strong correlation between the two dimensions internal and external cooperation structures (.793) and also between participation and internal respectively external cooperation (.601; .801). This finding suggests that teachers' perception of school structures referred mainly to a cooperative and democratic school structure in general.

## 7. Discussion and conclusion

In view of the current state of research, it must be borne in mind that the correlations between school structures and evidence-based actions that we found in our study were not as strong as expected (see Section 2). We found small to medium-sized correlations for *participation structures* only; the correlations for *communication and cooperation structures* and evidence-based actions were small or insignificant. The relatively weak or insignificant relationship identified between school structures and teachers' evidence-based actions indicates that the findings of previous research on the correlation between school structures and other professional orientations and actions of teachers' (discussed in Section 2) cannot be transferred or generalized to the specific context of evidence-based actions at schools, and that other factors at other levels such as those related to the school principals (see Stump et al., 2016) or to a school's culture (see Demski, van Ackeren & Clausen, 2016) must be given much more consideration in future research (see also Zlatkin-Troitschanskaia et al., 2016).

A crucial question with regard to theory and school practice is whether new school structures correlate *positively* with teachers' evidence-based actions. In accordance with the NGM, the overall results of this study indicate that teachers who

perceive school structures at their school as being well developed show comparably greater evidence orientation. Accordingly, schools with well-developed communication and information retrieval, internal and external cooperation, and participation structures are also more likely to have evidence-based school and classroom practices. However, the findings in their entirety indicate that these relationships are overall rather weak and insignificant. Consequentially, the question of influencing evidence-based actions at school requires further and more extensive theoretical and empirical research, which is scarce at the international level.

Our study and the analyses presented here are an important first step towards understanding the correlation between school structures and evidence orientation at the individual level of teachers. The next steps should include further, deeper analyses of causal and hierarchical relationships to examine the impact of different factors at the school level on teachers' evidence-based actions. The non-convergence of the multilevel models was due to the small sample size at the school level. The distribution of the variables over two questionnaire versions also reduced the number of schools for the analyses. To avoid this in the future only one questionnaire version was used in the follow-up study (for more details regarding the follow-up study, see Zlatkin-Troitschanskaia et al., 2016).

There are further important correlates that were not taken into account in this model. The analyses should be extended to include, for example, principals' responses. It would be interesting to examine the extent to which principals' professional orientations and actions are related to the various types of school-specific structures and also whether there is a direct influence of principals on teachers' evidence-based actions if communication, cooperation, and participation structures are controlled (see Stump et al., 2016).

With regard to methodology, the *causal* relationships could not be explored empirically in this study due to the limitations of the available cross-sectional dataset and sample size; however, corresponding longitudinal analyses were conducted in the follow-up project (see Zlatkin-Troitschanskaia et al., 2016).

The available data set was used to develop a structural equation model for teachers from all types of schools. The findings by Zlatkin-Troitschanskaia, Seidel, and Stump (2013) and Stump et al. (2016) suggest that the relationships between the analyzed variables might differ according to the type of school. Differences can be expected, for example, between vocational schools and general educational schools. Our findings could be differentiated according to school type in subsequent studies by means of multi-group analysis.

Furthermore, the results are based on self-reported measures. This raises general questions in the empirical research about the validity of self-reports. The associated problems and potential bias might have distorted our view of the existing school structures. Having said this, current research suggests that the correlations do not necessarily depend on the formal structures themselves, but to an important extent on teachers' individual perception of the suitability of these structures (e.g., Lingkost & Meister, 2011). Recent studies illustrate how formal structures can be interpreted differently by different individuals (e.g., Böhme & Kramer, 2011, p. 165;

Grundmann & Kramer, 2011, pp. 83 f.). Huppert and Abs (2008, pp. 10 f.) confirm that, in school evaluations, the perception of structures is a stronger influence factor than the actual structures themselves. Since the teachers' subjective perception of the structures is of great importance, self-reports can be a fair measure. To ensure objective modeling and measuring, evidence-based teacher actions in teaching practices, for instance in the context of the currently popular analyses of video-recorded lessons, should be explored explicitly in future research.

Another critical point is that the sample was not independent. Both the participating schools and teachers were not selected completely at random. Instead, we invited all schools and the teachers of all participating schools in the federal state to the study, but the teachers were free to decide whether or not to participate. As a consequence, we cannot draw definite inferences about the underlying population. Nonetheless, correlations are quite robust against lacking representativeness of the sample. We must also note that the survey was limited to schools in the German federal state of Rhineland-Palatinate. Even though we ensured that the sample included representative proportions of urban and rural schools as well as large and small schools, this does not enable conclusions about the representativeness of the findings for other federal states. In this context, further studies should focus not only on the school-specific structural level, but also on the governance contexts, which vary across the federal states (in Germany), as well.

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## Appendix A

Table A1: School types and percentage participants

School type	Number of schools	Percentage participants	Average school size (number of teachers)	Average participation quota per school <sup>a</sup>
Primary school	30	27.9 %	19	54.5 %
Vocational school	31	24.3 %	75	43.0 %
Junior high school	26	15.3 %	44	39.5 %
High school	20	13.4 %	62	36.3 %
Special needs	35	11.1 %	20	52.0 %
Integrated school	11	5.8 %	43	50.5 %

<sup>a</sup> Minimum participation quota: 8.43 %, maximum participation quota: 100.00 %.

Table A2: Descriptive statistics and reliability of scales

Scale	Example item	Number of items	Mean	SD	Cronbach's Alpha	Composite reliability
COMM	“At our school, we have access to the internet and the intranet to retrieve information on current job-related developments.”	3	3.517	.889	.679	.687
PART	“At our school, the teachers have a say in decisions that affect their work.”	3	3.625	.910	.833	.835
COOPINT	“At our school, we form quality groups/teacher networks to improve the quality of our work.”	4	3.241	.884	.782	.789
COOPEXT	“At our school, there is support for cooperation with other schools, companies or universities.”	3	3.668	.835	.736	.748
EE	“When making important decisions at our school, we often take into account expert reports.”	5	2.580	.779	.839	.847
IE	“Before adopting procedures from other schools, we analyze their effectivity.”	7	3.433	.743	.879	.882



Table A3: Correlation matrix of all latent variables

	COMM	PART	COOPINT	COOPEXT	IE	EE
COMM	1.000					
PART	.484**	1.000				
COOPINT	.579**	.601**	1.000			
COOPEXT	.535**	.801**	.793**	1.000		
IE	.487**	.711**	.535**	.673**	1.000	
EE	.488**	.526**	.534**	.499**	.709**	1.000

Note. N = 1,387.

\*\* p < .01.

Table A4: Regression weights of all latent variables

Variable	$\beta$	SE	p
IE			
COMM	.146	.037	.000
PART	.454	.068	.000
COOPINT	-.018	.071	.796
COOPEXT	.246	.103	.016
EE			
COMM	.214	.039	.000
PART	.350	.068	.000
COOPINT	.316	.075	.000
COOPEXT	-.146	.110	.182

Note. N = 1,387.