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Fostering sustained teacher learning: a longitudinal assessment of the influence of vision building and goal interdependence on information sharing

Arnoud Oude Groote Beverborg [a], Peter J. C. Sleegers[b], Nienke M. Moolenaar[c] and Klaas van Veen[d]

[a]Institut für Erziehungswissenschaft, AG Schulforschung/Schulpädagogik, Johannes Gutenberg Universität, Mainz, Germany; [b]BMC Consultancy, Amersfoort, the Netherlands; [c]Department of Education, Utrecht University, Utrecht, the Netherlands; [d]Faculty of Behavioural and Social Sciences, University of Groningen, Groningen, the Netherlands

ABSTRACT

To support school improvement, understanding the mechanisms that enhance teachers' engagement in professional learning activities within schools over time is paramount. The purpose of this three-wave longitudinal study is to examine the role of workplace conditions (school leaders' vision building and teams' shared goals), in supporting teachers' engagement in information sharing over time. To test the directionality of the relationships between the concepts, we analyzed survey data from 655 vocational education and training teachers in the Netherlands using a cross-lagged panel model. Results suggest that teachers' engagement in information sharing remains stable over time, and the results are indicative of reciprocity between goal interdependence and vision building. Mostly, the results hint at the complexity of the time-based relations involved in teacher learning in support of school improvement. Recommendations for future designs and methodologies to understand this complexity are discussed.

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Transformational leadership vision building; goal interdependence; sustained teacher information sharing; longitudinal reciprocal relations; cross-lagged panel model

Introduction

Teachers' engagement in professional learning activities within schools is vital to sustain the level of educational quality that is needed to prepare students for societal and occupational participation (Kwakman, 2003; Smylie, 1995; Stoll et al., 2006; van Veen et al., 2010). Research on teachers' learning in the workplace reflects that engagement in individual learning activities (e.g., self-reflection, keeping up to date, experimentation) alone is important, yet insufficient to effectively meet new educational demands (Jarvis, 1987; Stoll, 2009; Stoll et al., 2006). To successfully build school-wide capacity for school improvement and educational change, teachers' engagement in social learning activities is also important (Stoll et al., 2006; Toole & Louis, 2002; van Woerkom, 2003; Vescio et al., 2008). Through the exchange of information and ideas in social interaction with their colleagues, teachers are afforded opportunities to create new knowledge and skills,

CONTACT Arnoud Oude Groote Beverborg a.oudegrootebeverborg@uni-mainz.de

which supports school improvement (Nonaka, 1994; Paavola et al., 2004; Thoonen et al., 2012). However, research suggests that while teachers often recognize the benefits of sharing resources for individual learning, and are motivated to pool their expertise to determine a course of action aimed at improving education, sustaining high levels of information sharing over time has proven notoriously difficult (Gabelica et al., 2014; Horn & Little, 2010; J. Little, 1990; Schippers et al., 2003). Moreover, notwithstanding the tremendous efforts by governments, local politicians, and school managers to improve educational systems around the world, little is known about mechanisms that support information sharing as a social learning activity over time (Sleegers et al., 2014; Thoonen et al., 2012). Understanding how educational institutions can shape environments conducive to social interaction in support of teacher learning within schools is therefore needed (Decuyper et al., 2010; Giles & Hargreaves, 2006; Timperley & Alton-Lee, 2008).

Research on teachers' engagement in social learning activities consistently points towards the importance of a purposeful environment (Geijsel et al., 2009; Runhaar et al., 2010; Thoonen et al., 2011; Tjosvold, Tang, & West, 2004; Tjosvold, Yu, & Hui, 2004; Wahlstrom & Louis, 2008; Wiley, 2001). Characteristics of such a purposeful environment, such as leaders who support the development of a shared vision (transformational leadership) and teachers who perceive that they strive towards common goals (goal interdependence), have been consistently linked to increased social interaction in support of teacher learning, including information sharing (E. F. Cabrera & Cabrera, 2005; Johnson & Johnson, 2009; Mulford, 2010; Mullen & Hutinger, 2008; Scribner et al., 2007; Stoll et al., 2006; Tjosvold, 1986). The influence of the transformational leadership practice vision building on the learning activity information sharing is assumed to be mostly indirect (e.g., Oude Groote Beverborg, Sleegers, & van Veen, 2015a; Hallinger & Heck, 2011; Moolenaar et al., 2010; Runhaar et al., 2010). Research suggests that this relationship can be strengthened by teachers' perceptions of the organizational condition goal interdependence, that is, the extent to which teachers perceive that they are dependent upon each other to bring that shared vision as offered by the school leader to life (e.g., Sun & Leithwood, 2012; Wong et al., 2009).

However, the knowledge base on the interplay over time between vision building, goal interdependence, and teachers' information sharing is limited. Moreover, most studies aimed at understanding mechanisms underlying teacher interaction in schools are cross-sectional in nature, limiting valid and reliable claims about the directionality of the relationship (Cole & Maxwell, 2003; Eschleman & LaHuis, 2014; Maxwell et al., 2011; J. J. McArdle, 2009). Although different scholars have emphasized the need for using more longitudinal designs in school improvement research (Feldhoff et al., 2014; Hallinger & Heck, 2011; Heck & Hallinger, 2014; Sleegers et al., 2014; Thoonen et al., 2012), there is still little systematic evidence for how information sharing can be sustained, or elevated, in the context of the school over time. As such, this study was guided by the following research question:

> *How do vision building, goal interdependence, and teacher information sharing mutually shape each other over time?*

The study builds on a theoretical model about the interplay between transformational leadership practices, organizational conditions, psychological states, and learning activities

that was developed and tested in an elementary school context (Geijsel et al., 2009; Thoonen et al., 2012). In earlier work, we validated the structural relations of the interplay as specified by the model with data from a vocational education and training (VET) context and with additional concepts (Oude Groote Beverborg, Sleegers, Endedijk, & van Veen, 2015; Oude Groote Beverborg, Sleegers, & van Veen, 2015a, 2015b). In two cross-sectional studies, we found that goal interdependence (partly) mediated the extent to which the transformational leadership practice vision building affected information sharing (Oude Groote Beverborg, Sleegers, & van Veen, 2015a, 2015b). Additionally, in a longitudinal study we found evidence for reciprocity, indicating that influences do not flow in one direction only (Oude Groote Beverborg, Sleegers, Endedijk, & van Veen, 2015).

By now examining this theoretical model over time by focusing on three specific concepts, we can both validate previous findings and examine possible reciprocal relations undetected by earlier cross-sectional studies (e.g., Hallinger & Heck, 2011; Heck & Hallinger, 2010a; Nissilä, 2005; Salanova et al., 2006; Sleegers et al., 2014; Xanthopoulou et al., 2009). Additionally, longitudinal studies allow for an examination of change trajectories over time, that is, whether levels remain sustained, grow, or decline. This study's exploration of the potential dynamic reciprocal relationships between vision building, shared goals, and information sharing yields valuable insights into the nature and dynamics of the paths that link purposeful organizational conditions and teachers' opportunities for social learning.

Theoretical framework

To understand how transformational leaders' vision building, perceived goal interdependence, and teachers' engagement in information sharing change over time and how their interplay evolves over time in a VET context, we draw on theories on information sharing as a central ingredient for teachers' engagement in social learning, goal interdependence, and vision building.

Professional learning through teachers' engagement in information sharing

Inspired by adult learning theories and situated cognitive perspectives on teacher learning, we conceptualized professional learning as an active, constructive, and on-going process that is problem oriented, embedded within the school, and that takes place during the entire career (Jarvis, 1987; Kwakman, 2003; Marsick & Watkins, 1990; Putnam & Borko, 2000; Sleegers et al., 2005; Smylie & Hart, 1999). Ongoing, life-long learning is considered a natural component of the professional activities of teachers and thus a key component to improve the quality of instruction and build school-level capacity for sustained improvement (Clarke & Hollingsworth, 2002; Desimone, 2009). In line with this view, the focus of teacher learning in the context of the school is on teachers' engagement in a variety of professional learning activities aimed at stimulating their own professional development and the development of the school as a whole.

Although scholars have used a variety of different professional learning activities to capture teacher learning within schools (e.g., Kwakman, 2003; Meirink et al., 2009), a distinction can be made between individual and social professional learning activities

(Lohman, 2005; Schön, 1983; van Veelen et al., 2017; van Woerkom, 2003). Individual learning activities refer to activities aimed to explore and reflect on one's own values, interests, abilities, and career goals, and are carried out individually without any assistance from colleagues or supervisors. Examples of individual learning activities are self-reflection, keeping up to date, and focusing on future career goals. Social learning activities refer to activities aimed at acquiring new knowledge, skills, information, and ideas through social interaction with others. Examples of social learning activities are sharing information, asking for feedback, and challenging groupthink. Although both types of learning activities are ways to discover the proper script for future actions and are nested in a social context, the sources and thereby the nature of these learning activities differ. As indicated, in this study we focus on sharing information as one of the most important social learning activities teachers are engaged in during their daily practice.

Information sharing among teachers reflects the extent to which teachers offer or receive ideas, insights, advice, and feedback from their colleagues. During the exchange of information, teachers have the opportunity to explicate, discuss, create, and spread knowledge and skills (Spillane et al., 2012; van Woerkom, 2003, 2004), which may enhance their teaching practices, and contribute to organizational improvement (Desimone, 2009; Garet et al., 2001; Korthagen, 2001; Kwakman, 2003; Thoonen et al., 2011). Information as such refers here to any form of work-related message that has utility for the relevant practitioners, including personal, subject-specific, subject-transcending, and college-related experiences, methods, facts, or other content (Feldhoff, 2011; Louis & Dentler, 1988; Moolenaar et al., 2012). Information sharing is seen as a facilitator of innovation and decision quality (Nonaka, 1994; van Knippenberg et al., 2004), and has been positively related to performance (Quigley et al., 2007; Staples & Webster, 2008; Tjosvold, Tang, & West, 2004).

Findings from research on professional learning communities (Stoll et al., 2006; Toole & Louis, 2002; Vescio et al., 2008), organizational learning (Leithwood & Louis, 1998; Louis & Lee, 2016), and social networks in schools (Moolenaar et al., 2012) suggest that the extent to which teachers share information can make a significant contribution to improving educational practice and, in turn, increasing student performance. However, such studies are mostly cross-sectional – conducted at one point in time – and as such offer limited understanding of how teachers exchange and share information over a longer period of time. This is especially salient as research suggests that in some cases, it is difficult to keep up high levels of information sharing among teachers over time (Giles & Hargreaves, 2006). Yet, sustained levels of information sharing over time are important for maintaining high levels of craftsmanship, because solutions that were once successful may expire as circumstances continuously change (Klarner et al., 2008; Korthagen & Vasalos, 2005; Tjosvold, 1991). Moreover, insights into how the school environment may support prolonged information sharing over time are limited.

We argue in this paper that a purpose-rich environment, which may be vital to sustained information sharing by teachers, is stimulated on the one hand by teachers' perceptions of goal interdependence and on the other hand by leaders' effort in building a vision (Geijsel et al., 2009; Runhaar et al., 2010; Thoonen et al., 2011; Tjosvold, Tang, & West, 2004). We will now discuss these two elements in greater detail.

Goal interdependence

Goal interdependence refers to the degree to which teachers perceive common goals for the team and the extent to which each team member feels responsible to contribute to the pursuit of those mutual goals. When goal interdependence is high, employees' personal benefits and costs depend on the successful goal attainment of the team, implying that interaction is required for teachers to reach their own goals as well as to support team members to reach theirs (Deutsch, 1980; Runhaar, 2008; Runhaar et al., 2014; van der Vegt et al., 2000; van der Vegt & Janssen, 2003; Weldon & Weingart, 1993).

Research suggests that goal interdependence is positively related to knowledge sharing, the exchange of information, and the development of new insights and discoveries, as well as to increased social reflective learning and innovation (Ortiz et al., 1996; Oude Groote Beverborg, Sleegers, & van Veen, 2015a, 2015b; Runhaar et al., 2010, 2014; Tjosvold, Tang, & West, 2004; Tjosvold, Yu, & Hui, 2004). By pursuing a common goal, teachers may provide each other with direction and support, thereby specifying a course of action. Creating purpose in this way structures uncertainty and ambiguity, and thus strengthens teachers' information sharing (Staples & Webster, 2008; see also A. Cabrera & Cabrera, 2002; van der Vegt et al., 2003; van Knippenberg et al., 2004).

While perceptions of goal interdependence may affect teachers' information sharing over time, the opposite may also be true: Teachers' information sharing over time may increase their perceptions of goal interdependence. Teachers may spend time and interact with colleagues in order to figure out adequate ways to formulate and pursue common goals. In other words, "… those in schools must learn how to lose time in order to gain time" (Mulford, 2010, p. 198). Information sharing may also help in monitoring goals to come to solutions to changes and challenges at work. When teachers find adequate ways of interaction for goal attainment, sharing and discussing information with colleagues can then again be beneficial to their own learning (Desimone, 2009; Horn & Little, 2010; Nonaka, 1994; Spillane et al., 2002; Weick et al., 2005). In this study, we therefore hypothesize that:

Higher levels of perceived goal interdependence will increase teachers' engagement in information sharing over time (Hypothesis 1a)

On the basis of the reciprocal associations between these concepts, we also hypothesize that:

Higher levels of teachers' engagement in information sharing will increase teachers' perceived goal interdependence over time (Hypothesis 1b)

Leaders' vision building

In addition to goal interdependence, leadership is another element that typifies environments rich in purpose that may stimulate information sharing among teachers over time. While many types of leadership are discussed in educational literature (e.g., instructional leadership, distributed leadership), we focus on one type that has been particularly associated with its ability to affect educational change and the importance of teacher interaction, namely, "transformational leadership" (Leithwood et al., 1999). A transformational leader aims at development in a context of organizational change and is committed to the

empowerment of individual teachers and the team as a whole (Avolio et al., 2004; Bass & Avolio, 1994; Leithwood et al., 2002; Leithwood & Sleegers 2006; Yammarino et al., 2008). Research has shown that transformational school leadership can foster participation in decision making, enhance teachers' engagement in professional learning activities, and strengthen the effect of a professional community on student achievement (Geijsel et al., 1999; Sun & Leithwood, 2012; Thoonen et al., 2011; Wiley, 2001). In addition, transformational school leadership has been found to enhance prerequisites for perceiving interdependence, such as trust (Moolenaar et al., 2012, 2014; Thoonen et al., 2011).

While transformational leadership literature indicates several dimensions of leadership that are instrumental to educational change (e.g., Geijsel et al., 2009; Thoonen et al., 2012), in this study, we focus on leaders' efforts in building a shared vision (see also Leithwood & Sun, 2012), as earlier studies clearly showed that this dimension is associated with teachers' information sharing and goal interdependence in a VET context (Oude Groote Beverborg, Sleegers, & van Veen, 2015a, 2015b). Leaders who initiate and articulate a shared vision, support the development of shared goals and priorities, and stimulate teachers to share information to formulate, connect, commit, and strive to achieve shared goals. By building a shared vision, leaders shape a purposeful environment in which teachers are more likely to pursue common goals and share information. Research has found that leaders' efforts in building a vision affect perceptions of goal interdependence (Wong et al., 2009) and that this was also related to sharing information (Oude Groote Beverborg, Sleegers, & van Veen, 2015a, 2015b). Although these findings suggest that leaders' vision building affects both perceived goal interdependence and information sharing, longitudinal research is needed to assess the manner in which transformational leadership impacts teachers' perceptions of goal interdependence and their information sharing over time. Based on the aforementioned, we therefore hypothesize that:

Higher levels of leaders' vision building will increase teachers' perceptions of goal interdependence over time (Hypothesis 2a)

Higher levels of leaders' vision building will increase teachers' perceptions of goal interdependence over time (Hypothesis 2a)

Furthermore, a reverse relationship between leadership and goal interdependence may also emerge over time. A vision cannot manifest when teachers do not enact it (see also Louis & Lee, 2016; Spillane et al., 2002). By interacting to attain common goals, and learning how to effectively do so through sharing information, teachers may inspire their leader to continue working on a shared vision. It has indeed been proposed that, in the long term, building teacher craftsmanship may strengthen organizations' capacity for change and transform leadership from an individual characteristic to more distributed forms, such that it diffuses first through the team, and finally through the organization (e.g., Day et al., 2010; Hallinger & Heck, 2011; Harris et al., 2007; Heck & Hallinger, 2010b; Spillane & Healey, 2010). Interacting with colleagues in pursuit of common goals perhaps contributes to this process, because it may elevate levels of potentially useful knowledge to enhance both individual and collective capacity (Sleegers et al., 2013). On the basis of a dynamic representation of the associations between these concepts, we also hypothesize that:

Higher levels of leaders' vision building will increase teachers' perceptions of goal interdependence over time (Hypothesis 2a)

Higher levels of teachers' engagement in information sharing changes will increase leaders' vision building over time (Hypothesis 3b)

The present study

The aim of the present study is twofold. First, because the literature on vision building by the school leader, teachers' perceived goal interdependence, and teachers' engagement in information sharing does not provide a basis for an expectation of their dynamics, we will explore their change over time. Second, we will assess the potential reciprocal relations of these concepts by testing six hypotheses that were based on previous studies. The model that guided this inquiry is depicted in Figure 1. To test this model, we conducted a longitudinal study (with three time points with yearly intervals; see also Sleegers et al., 2014; Thoonen et al., 2012) to gather data among Dutch VET teachers.

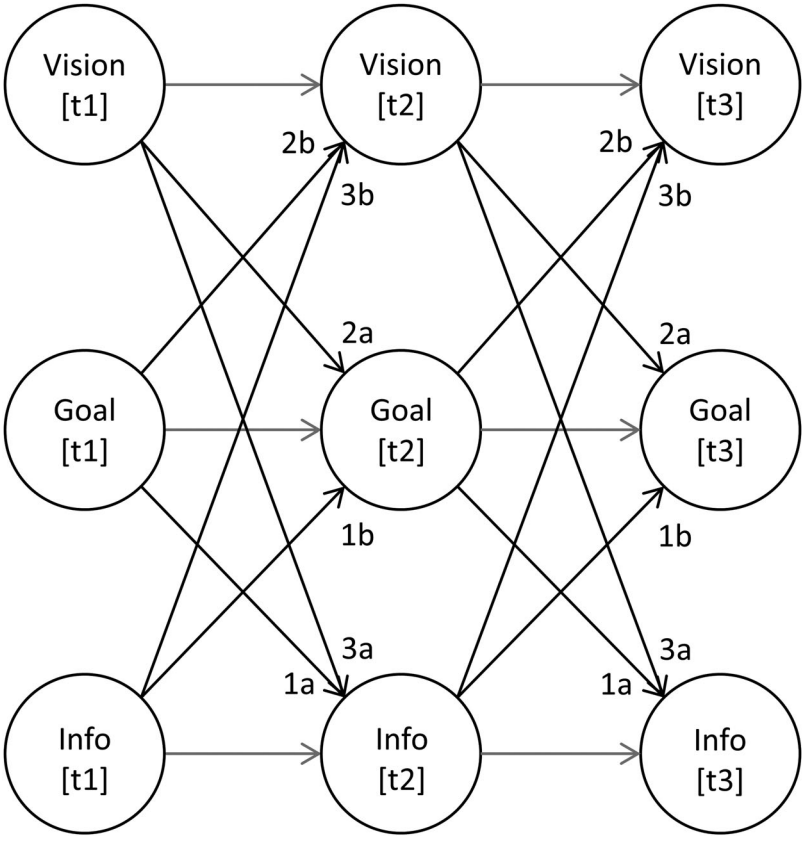

Figure 1. Theoretical framework of how information sharing (Info) is influenced by perceived goal interdependence (Goal), and the transformational leadership practice vision building (Vision) over time, as well as their reciprocal relations.

Note: The arrows numbered 1a–3b represent the hypotheses. The change of each concept will be explored.

We analyzed the data using a structural equation modeling (SEM)-based modeling technique: cross-lagged panel modeling (CLP). In the following section, we will describe our sample, assess the validity of our measures, and describe the CLP model and our strategy to assess the change of the constructs, as well as how they are related over time. Results regarding the constructs' changes and reciprocal relations will be reported thereafter in the Results section.

Method

Sample and context

We tested the time-based relationships between our concepts using data gathered during 3 consecutive years among 655 Dutch teachers in six VET colleges in the Netherlands (for VET colleges in the Netherlands, see also Poortman, 2007; Truijen, 2012). VET colleges are organized in departments (e.g., technology, economics and business, health and welfare, education) and offer education in various workplace-oriented educational programs to prepare students for various professional roles in different working fields. Dutch VET colleges have experienced large-scale changes in recent years. To improve efficiency, many colleges have merged into large educational institutions. Traditional classroom environments have been turned into authentic learning environments that replicate the workplace, building on the idea that craftsmanship is acquired in practice rather than in a classroom. To further bridge the gap between VET and practice, VET colleges have attracted experienced professionals to teach students, resulting in a teaching staff from diverse backgrounds, with varying levels of experience and expectations toward students and collegial interaction.

To accommodate these changes, VET colleges have started to work in multidisciplinary teams in which teachers are expected to collaborate across disciplines (see also Meirink et al., 2009, 2010). Multidisciplinary teams are responsible for teaching a fixed group of students (class), the skills that are needed for their future professions, guiding their learning processes, planning the group's curricula, and assessing their progress. However, due to the traditionally individualistic nature of the profession (Somech & Bogler, 2002), many teachers are unfamiliar with working in multidisciplinary teams. Supporting such teams requires leadership practices that connect teachers that are educating for the same profession throughout the colleges' departments, such as building a common vision, negotiating shared goals, and creating social learning opportunities to strengthen professional expertise and educational practice, with the ultimate goal of improving student performance. As such, this VET context offers a valuable backdrop to our study, because vision building as a transformational leadership practice and collegial interdependence have been paramount to ensure a successful large-scale transition to facilitate teachers' social learning.

The six VET colleges in our sample were located throughout the Netherlands. Two colleges were half the size of the other four colleges, but all colleges appeared to be similar otherwise. We therefore do not take college characteristics into consideration in this study. Data were collected from teachers of multidisciplinary teams from various departments in the colleges. We used convenience sampling to obtain a sample as large as possible. The leadership of the six VET colleges was contacted through their boards of directors.

Subsequently, teachers at two of the colleges were contacted directly via email to invite them to participate (the mean response rate over the three measurement points and the two colleges was 27%). For the other four colleges, we asked team leaders if their teams would be willing to participate, and only contacted teachers via email after receiving consent from the team leader (the mean response rate over the three measurement points and the four colleges was 64%). During 3 years (from 2010 to 2012), questionnaires were sent to more than 800 teachers. On each time point, about 400 teachers returned the questionnaire, with response rates of 53%, 52%, and 47% for the three sequential occasions. From the six VET colleges in our sample, respectively 182, 130, 120, 88, 75, and 60 teachers participated on at least one time point. Subsequent analyses are based on the data of 655 unique respondents, of which 144 responded on all three occasions, 181 responded on two occasions, and 330 responded on only one occasion[1] (see Appendix 1, Table A1.1).

Over three time points, and of all respondents, the average age was 48 years ($SD = 10$ years). The majority of the respondents worked more than 32 hr per week (about 60%). Many of the respondents had worked as a teacher for more than 20 years (32%); a sizeable percentage had worked around 10 years as a teacher (21%). Most of the teachers had a bachelor's degree (72%) (see Appendix 1, Table A1.2).

Measures

The following concepts were assessed using scales that were found valid and reliable in earlier research, namely, vision building (5 items), goal interdependence (3 items), and information sharing (7 items) (see Appendix 2). The previously reported reliabilities of these scales ranged between .71 and .94 (Cronbach's α) (Geijsel et al., 2009; Oude Groote Beverborg, Sleegers, & van Veen, 2015a, 2015b; Runhaar, 2008; Thoonen et al., 2012; van der Vegt et al., 2000; van Woerkom, 2003).

In order to ascertain that the data can be used in a longitudinal model, we assessed (a) whether the data were normally distributed, (b) the configural and metric temporal invariance of the factor structures, and (c) the mapping of the measures onto their constructs. We used Mplus 7.1 (Muthén & Muthén, 1998–2012) for all analyses. Mplus provides maximum likelihood estimation and the expectation maximization algorithm for data sets with missing data (Muthén & Muthén, 1998–2012; Sbarra & Allen, 2009; see also Cillessen & Mayeux, 2004; J. J. McArdle & Prindle, 2013).

Visual inspection revealed that all items had normal or roughly normal distributions. We conducted exploratory factor analyses for each scale on each measurement occasion. On the basis of these analyses, we removed two items from the information sharing scale. Then we started to construct the measurement model. We performed one confirmatory factor analysis with all three constructs on all three time points. The results showed that the items loaded well on their factors for all three time points. We then investigated whether the constructs measured the same concepts over time, by testing a model with factor loadings varying freely across the three time points versus a model in which each item's factor loadings were constrained to be equal over time (weak invariance) (see also J. J. McArdle & Prindle, 2013). The findings showed that our measures were invariant over time and that the latent ("true") scores of the constructs could be separated from the random error of measurement. We then investigated whether we could model the

means of the factors by testing the weak invariance model against that model with invariant item intercepts (strong invariance). The test showed that modeling means was allowed. See Appendix 2 for the invariance tests. The final measurement model with strong invariance had the following fit measures: $X^2(706) = 1441.822$ ($p = .000$), the root-mean-square error of approximation [RMSEA] = 0.040, the comparative fit index [CFI] = 0.917, the standardized root-mean-square residual [SRMR] = 0.057.[2,3] These fit measures provide a first indication of the longitudinal applicability of the scales, which were developed in cross-sectional research, in this context (see Appendix 3 for the items, factor loadings, item intercepts, and residual variances, and Appendix 4 for the means, standard deviations, and correlations between all factors at all time points).

Analytic strategy

In order to assess the time-based relationships between vision building, perceived goal interdependence, and teachers' information sharing, we used cross-lagged panel modeling (T. D. Little et al., 2007; Selig & Preacher, 2009; Zyphur et al., 2019; see also Aunola et al., 2006; Simbula et al., 2011). In the CLP models, each construct's factors were connected over time through autoregressions. The constructs were related with one another through covariances and cross-lagged regressions, and their disturbance terms were correlated within time points. The cross-lagged regressions test for the influence of one construct (e.g., goal interdependence) on another (e.g., information sharing) over time. These parameters may be in one direction (e.g., from goal interdependence at t1 to information sharing at t2), but may also be bidirectional (e.g., also from information sharing at t1 to goal interdependence at t2), such that reciprocity between constructs becomes a testable property of the model. This approach strengthens claims of causality[4] and mediation (e.g., Cole & Maxwell, 2003; Eschleman & LaHuis, 2014). Moreover, we included a mean structure, which allowed assessment of change relative to the second time point by setting the factor intercepts of that time point to 0. We used this assessment and the constancy of the autoregressions to explore change of the constructs over time.

We first estimated a model that included all hypothesized relations. Then, we assessed which hypothesized relations could be excluded by comparing the full model to a more restrained (parsimonious) model. The models were compared using the chi-square difference (ΔX^2) test with degrees of freedom (*df*) equal to the difference in numbers of parameters free for estimation. A significant ΔX^2 test indicates a worsening of fit through restrictions; thus, significance indicates that the unrestricted model, that is, the one with more free parameters and thus a lower degree of freedom, should be reverted to, and vice versa.

Results

To test our hypotheses, we examined the relationships between the constructs of our study (vision building, goal interdependence, and information sharing) over time, as well as their change over time using cross-lagged panel modeling and included the mean structure. The cross-lagged regressions thus represent our hypotheses and provide the evidence for the direction of influence between the concepts.

The fit of the first test of the full cross-lagged panel model of the theoretical model was $X^2(715) = 1470.792$, $p = .000$; RMSEA = .040; CFI = .915; SRMR = .063. This model indicated

that mean levels of information sharing were constant ($\mu_{Info1} = -0.005$, $p = .960$ and $\theta_{Info3} = 0.010$, $p = .819$), and that mean levels of goal interdependence and vision building increased between Time Points 1 and 2 ($\mu_{Goal1} = -0.235$, $p = .049$ and $\mu_{Vision1} = -0.189$, $p = .039$), after which their levels were sustained ($\theta_{Goal3} = -0.026$, $p = .600$ and $\theta_{Vision3} = -0.015$, $p = .763$). Notably, the values of the autoregressions of goal interdependence and vision building increased by about 0.3 points ($\beta_{Goal1} = 0.582$, $p = .000$; $\beta_{Goal2} = 0.858$, $p = .000$; $\beta_{Vision1} = 0.582$, $p = .000$; $\beta_{Vision2} = 0.858$, $p = .000$), whereas those of information sharing remained more or less constant over time ($\beta_{Info1} = 0.634$, $p = .000$; $\beta_{Info2} = 0.743$, $p = .000$).[5]

Moreover, the results showed that this model had two significant cross-lagged regressions ($\beta_{Vision1 \rightarrow Info2} = 0.147$, $p = .000$; $\beta_{Goal1 \rightarrow Vision2} = 0.185$, $p = .018$) and two marginally significant cross-lagged regressions ($\beta_{Vision2 \rightarrow Goal3} = 0.126$, $p = .062$; $\beta_{Info2 \rightarrow Goal3} = -0.183$, $p = .072$). All other cross-lagged regressions were nonsignificant (p values larger than .350). As such, this model indicated that the interplay between the constructs was not constant over time and that reciprocity was limited.

We also tested the full CLP model against a parsimonious version in which all but significant and marginally significant cross-lagged regressions were removed (see Table 1 and Figure 2). The test indicated that the parsimonious model did not fit worse to the

Table 1. The estimates from the parsimonious cross-lagged panel model.

Parameter	Vision		Goal		Info	
Mean μ_{y1}	−0.187	*	−0.227	†	−0.008	
Intercept[2] θ_{y2}	@0		@0		@0	
Intercept[3] θ_{y3}	−0.018		−0.028		0.006	
Variance ϕ_{y1}^2	0.842	**	0.590	**	0.381	**
Residual variance[2] ω_{y2}^2	0.407	**	0.318	**	0.113	**
Residual variance[3] ω_{y3}^2	0.397	**	0.151	**	0.174	**
Autoregression1 β_{y1}	0.355	**	0.603	**	0.638	**
Autoregression2 β_{y2}	0.725	**	0.844	**	0.749	**
Cross-lagged regressions $\beta_{x[t-1] \rightarrow y[t]}$						
Vision[1] → Goal[2]	–					
Vision[2] → Goal[3]	0.140	*				
Vision[1] → Info[2]	0.131	**				
Vision[2] → Info[3]	–					
Goal[1] → Info[2]			–			
Goal[2] → Info[3]			–			
Goal[1] → Vision[2]			0.184	**		
Goal[2] → Vision[3]			–			
Info[1] → Vision[2]					–	
Info[2] → Vision[3]					–	
Info[1] → Goal[2]					–	
Info[2] → Goal[3]					−0.190	*
Covariances ϕ_{xy1} and correlated disturbance terms ω_{xy2} and ω_{xy2}	Goal[t]		Info[t]			
Vision[1]	.286	**	.176	**		
Goal[1]			.198	**		
Vision[2]	.062	*	.048	*		
Goal [2]			.081	**		
Vision[3]	.079	*	.054	*		
Goal [3]			.089	**		

Note: $N = 655$, # free parameters = 96. Vision = transformational leadership vision building; Goal = goal interdependence; Info = information sharing. Time Points 1, 2, and 3 are indicated with [1], [2], and [3], respectively, and [t] indicates time point. @0 indicates that this intercept was set to 0 at this time point in order to estimate the means and intercepts at the other time points (whose values are therefore relative to 0). – indicates that this cross-lagged regression was removed to create the parsimonious model. The values are the unstandardized parameter estimates. Factor loadings, item intercepts, and error variances are not listed; see, for an approximation, Appendix 3. See also Figure 2 for a graphical representation of these results. The model's fit measures are: X^2 (723) = 1472.664, $p = .000$; RMSEA = .040; CFI = .916; SRMR = .064.
**$p < .01$. *$p < .05$. †$p < .07$.

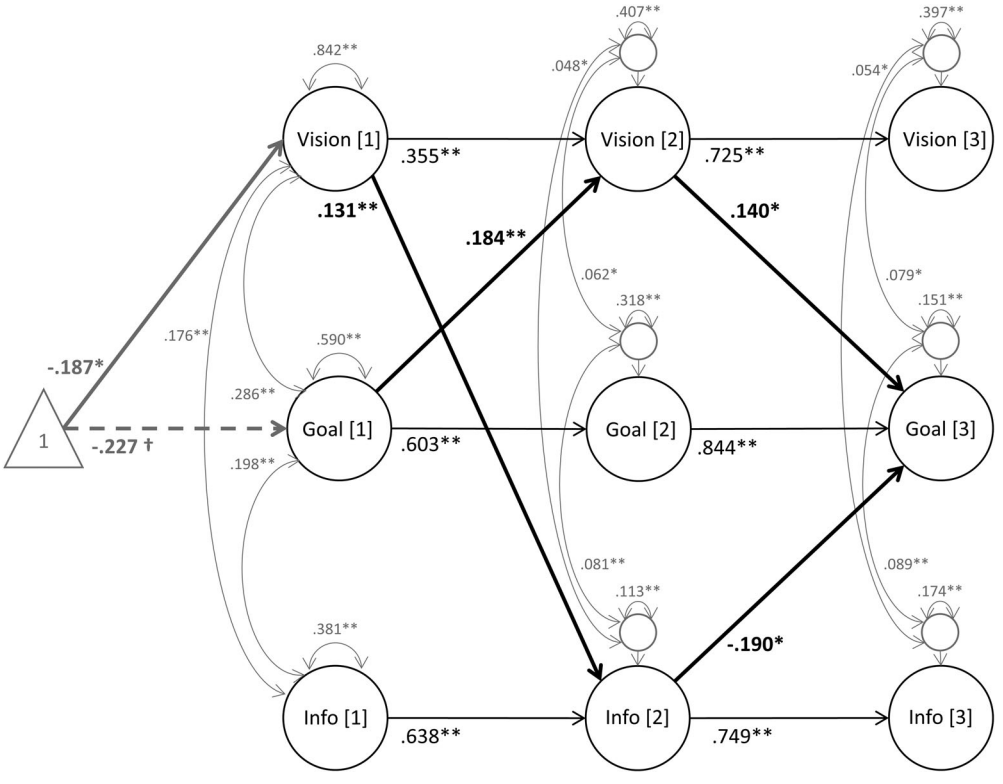

Figure 2. The estimates from the parsimonious cross-lagged panel model.

Note: This figure gives the values in Table 1 in graphical form. Bold and grey are used to create contrast to make the graph easier to read. Because of readability, the factor loadings, the item intercepts, and the measurement errors are not shown; see, for an approximation, Appendix 3. Vision = transformational leadership vision building; Goal = goal interdependence; Info = information sharing. [t]s represent the time point factors. The triangle represents a constant with a mean of 1 and variance of 1. The arrows from the constant to the factors give their means (μ_{y1}) relative to the factor intercepts at Time Point 2 (θ_{y2}), which were set to 0. The intercepts at Time Point 3 (θ_{y3}), and the mean from information sharing (μ_{Info1}) do not deviate from 0 and are not shown. The black arrows are the autoregressions (β_{y1} and β_{y2}). The bold black arrows are the cross-lagged regressions ($\beta_{x[t-1]\rightarrow y[t]}$). The grey curved arrows are the variances (ϕ^2_{y1}), the residual variances (ω^2_{y2} and ω^2_{y2}), the covariances (ϕ_{xy1}), and the correlations between the disturbance terms (ω_{xy2} and ω_{xy3}). The values are the unstandardized parameter estimates. The model's fit measures are: X^2 (723) = 1472.664, p = .000; RMSEA = .040; CFI = .916; SRMR = .064. **p < .01. *p < .05. †p < .07.

data than the full model ($\Delta X^2(8) = 1.872$, $p = .985$; $X^2(723) = 1472.664$, $p = .000$; RMSEA = .040; CFI = .916; SRMR = .064). This model had four cross-lagged regressions ($\beta_{Vision1\rightarrow Info2} = 0.131$, $p = .000$; $\beta_{Goal1\rightarrow Vision2} = 0.184$, $p = .008$; $\beta_{Vision2\rightarrow Goal3} = 0.140$, $p = .029$; $\beta_{Info2\rightarrow Goal3} = -0.190$, $p = .049$). Notably, the mean of goal interdependence was marginally significant in this model ($\mu_{goal1} = -0.227$, $p = .060$).[6] We will relate the results of our final model to the hypotheses.

The results do not provide support for Hypotheses 1a and 3b. The cross-lagged regressions from goal interdependence to information sharing and from information sharing to vision building were not significant in the final parsimonious model. Higher perceptions of goal interdependence do not lead to higher engagement in information sharing among teachers, and higher engagement in information sharing does not lead to higher leaders' vision building practices.

The results provide partial support for Hypothesis 1b in the sense that engagement in information sharing among teachers can in some circumstances relate to perceptions of goal interdependence. The cross-lagged regression between Time Points 2 and 3 from information sharing to goal interdependence was significant in our final parsimonious model. The cross-lagged regression between Time Points 1 and 2 was not significant. However, engagement in information sharing was found to have a negative influence on perceptions of goal interdependence, which is contrary to our hypothesis.

The results provide partial support for Hypothesis 2a. The cross-lagged regression between Time Points 2 and 3 from vision building to goal interdependence was significant in the final parsimonious model. The cross-lagged regression between Time Points 1 and 2 from vision building to goal interdependence was not significant. Higher leaders' vision building practices might in some circumstances positively influence perceptions of goal interdependence.

The results provide partial support for Hypotheses 2b and 3a. The cross-lagged regressions between Time Points 1 and 2 from goal interdependence to vision building and from vision building to information sharing were significant in the final parsimonious model. The cross-lagged regressions between Time Points 2 and 3 from goal interdependence to vision building and from vision building to information sharing were not significant. Perceptions of goal interdependence can in some circumstances positively influence leaders' vision building practices, and leaders' vision building practices can in some circumstances positively influence engagement in information sharing among teachers.

Additionally, the results of the final parsimonious model with regard to the exploration of change over time indicated that the stability of information sharing was constant over time in terms of both its levels (equality of factor means and intercepts) as in its prediction of itself (invariance of autoregressions). Moreover, the results showed a limited indication that goal interdependence increased between Time Points 1 and 2 (the mean was lower than the intercept at Time Point 2, and this difference was marginally significant in the final parsimonious model), and that it remained stable between Time Points 2 and 3. The stability of goal interdependence increased in terms of its prediction of itself (increase of the autoregressions over time). For vision building, the results indicated a clearer pattern of increase of stability: Its level increased between Time Points 1 and 2 (the mean was significantly lower than the intercept at Time Point 2), and its prediction of itself also increased (increase of the autoregressions over time).

In the remainder of this text, we will discuss these inconclusive results in terms of the limitations of the present study and theory in the current literature, and we will propose suggestions for future research.

Limitations of the present study

One major source of the inconclusive results could be the many missings in the data set. About 50% of the participants responded on only one measurement occasion (and only 22% responded on all three measurement occasions). As contacting teachers to participate via their team leaders yielded a response rate that was nearly 2.5 times as high as contacting teachers to participate directly, simple convenience sampling would seem to be a less adequate sampling strategy for gathering valid and reliable longitudinal data.

The many missings on measurement occasions make the estimation of the lagged regressions (cross and auto) less reliable. It might be that the marginally significant cross-lagged regressions in the full model would be found to be true in the population if we would have had more power (less missings over measurement occasions). On the other hand, their marginal significance may also represent that the effect is only true for a certain subset of participants or teams. This could be assessed using latent class analysis and/or multilevel analysis. Because we did not have enough power, we were unable to conduct such analyses. Additionally, more precise but also more complex models (see also Mund & Nestler, 2019) such as the random intercept cross-lagged panel model (Hamaker et al., 2015), which accounts for trait-like, time-invariant, inter-individual differences, or the latent change score model (e.g., Eschleman & LaHuis, 2014; Grimm et al., 2012; J. J. McArdle, 2009; J. J. McArdle & Hamagami, 2001), which accounts for intra-individual change, would also yield biased results when applied to our data, due to the missings on measurement occasions.

Another possible source of bias of our results is the yearly interval between the measurement occasions. Depending on the length of time between measurement occasions, cross-lagged regressions can take larger or smaller and even positive or negative values (Kuiper & Ryan, 2018). Because our study did not have enough density of measurements, we could not assess the magnitude and sign of regressions with different lags. Consequently, we could not ascertain whether the inconstancy of the cross-lagged regressions was due to our measurement or whether the relations between the concepts were truly differentiated over time (see also Coman et al., 2014; Feldhoff et al., 2016; Orton & Weick, 1990; Zyphur et al. 2019).

Discussion

Our study tested the longitudinal, reciprocal relationships between vision building, perceptions of goal interdependence, and VET teachers' information sharing. Data of three time points with yearly intervals of a total of 655 participants were used for the analyses. To assess the change of each construct and to assess the longitudinal relations between the constructs, we applied CLP models with mean structures.

Concerning our exploration of change, we found that levels of information sharing were very stable within the time frame and with the measurement interval of this study. The finding that initial levels of information sharing were high (see Appendix 4) might indicate that teachers already shared work-related information with colleagues and sought advice at the onset of the study. It could be that, as a consequence of being organized in multidisciplinary teams, teachers had planned regular meetings, the frequency of which is positively associated with exchanging information (Somech & Drach-Zahavy, 2007). More longitudinal research is required to understand sustainment and change of information sharing and other forms of teacher learning in the workplace over time. Moreover, future longitudinal studies should assess whether sustained high levels of information sharing will lead to changes in teaching practices and, consequently, to improved student learning (e.g., Desimone, 2009).

The results also showed that mean levels of goal interdependence and vision building may increase over a short period of time (between Time Points 1 and 2, after which their levels did not increase further). The initiation of teams may have led to a short boost in the

vision-building practice of leaders and perceptions of the need to interact to pursue common goals of teachers across the entire sample. Studies designed to capture more variation by measuring longer and denser will grant more insight into the dynamics of this process.

The results did not support our assumption that higher perceptions of goal interdependence lead to higher information sharing among teachers over time. Teachers' perceptions of striving towards common goals did not influence seeking each other for feedback, advice, and discussion. This finding contrasts with findings about the beneficial role of collaboration and social interaction with team members in pursuing common goals in elevating levels of teachers' engagement in social learning activities (Runhaar et al., 2010, 2014; Tjosvold, Tang, & West, 2004; Tjosvold, Yu, & Hui, 2004). One reason for this contrast may be that goal interdependence and social learning are often conceptualized at the team level, measured with "we" items, and modeled at the team level. In this study, however, both goal interdependence and information sharing were not measured with "we" items (see Appendix 3: Goal interdependence was measured with "we" items, while information sharing was measured with "I" items) and modeled at the team level (we did not conduct multilevel analysis, see limitations). As such, these differences may be related to the issue of multilevel homology, indicating that the relation between goal interdependence and social learning may have a different meaning at multiple (individual and collective) levels of analyses (see Klein et al., 1999; Rousseau, 1985). In future research, scales that clearly distinguish between social learning efforts of teams and individuals as well as between team and individual expected benefits of those efforts are needed to unravel this issue. Moreover, this result contrasts specifically with previous cross-sectional findings based on the same scales (Oude Groote Beverborg, Sleegers, & van Veen, 2015b). Whereas cross-sectional studies derive the modeled direction of influences solely from theory, longitudinal studies can model reciprocal relations and test the influences in both directions empirically.

In contrast to our assumption, we found a negative influence from teachers' engagement in information sharing on their perceptions of goal interdependence. The influence from information sharing to goal interdependence occurred in the wake of a (possible) increase of goal interdependence and co-occurred with an increase in the stability of goal interdependence. As the pursuit of a common goal crystalizes over time, these results seem to suggest that teachers' discussions and exchange of advice and feedback can start to counteract the degree to which teachers perceive common goals over time. Future research that measures denser, longer, and with more differentiated scales is needed to assess how the influence from information sharing on goal interdependence evolves.

We also found partial support for our assumption of the positive influence of vision building on goal interdependence. The influence from vision building of leaders on perceptions of goal interdependence of teachers also occurred in the wake of a (possible) increase of goal interdependence and co-occurred with an increase in the stability of goal interdependence. In contrast to the previously discussed finding, the results showed that, as the pursuit of a common goal crystalizes over time, leader's vision building practices can start to strengthen this development. Although this finding confirms earlier findings from (cross-sectional) studies that showed a positive impact of transformational leadership practices on collaboration and trust between teachers (Geijsel et al., 2009;

Moolenaar et al., 2012; Thoonen et al., 2011; Wong et al., 2009), it also suggests that this impact may differ over time.

The results also provided partial support for our assumption that goal interdependence and vision building are positively related over time. The influence of teachers' perceptions of goal interdependence on leaders' vision building co-occurred with an increase of vision building but before vision building became more stable. As such, the findings showed that, as teachers pursue common goals, they can help their leader to develop in the building of a shared vision and that the impact of goal interdependence on vision building differs over time. This suggests that vision building as a leadership practice may be meaningful when teachers are already working towards the attainment of common goals. Future research will have to assess under which conditions vision building and goal interdependence mutually affect each other over time.

We found partial support for our assumption that vision building has a positive influence on information sharing. The influence of leaders' vision building on teachers' information sharing was found to occur between Time Point 1 and Time Point 2. A leader who inspires others to formulate shared goals and repeatedly articulates a shared vision can positively influence teachers to share information. That this influence was found to differ over time may be related to the time it takes to develop and consolidate teaching practices. After a leader has given the first impulses to work toward a shared vision, teachers may focus their learning on how to adjust their teaching practices toward this shared vision and therewith become irresponsive to further impulses for a while (Coburn, 2001, 2004; Mulford, 2010; Spillane et al., 2002). The finding adds to the discussion about the role leadership can play in creating social learning opportunities to strengthen teachers' professional expertise (e.g., Dionne et al., 2004) and connects with the view that shaping intentions is crucial for learning processes to occur. When school leaders help to diminish ambiguity and uncertainty by articulating a shared vision, and thereby providing directions for courses of action, they can foster teachers to share information and find (their own) situated solutions for the teaching challenges they are faced with (see also Barab et al., 1999; Weick, 1995; Weick et al., 2005).

Finally, we did not find support for the assumption that information sharing has an impact on vision building. Higher levels of teachers' engagement in information sharing did not affect levels of leaders' vision building. Apparently, teachers' exchange of ideas, insights, advice, and feedback with their colleagues is not what inspires their leader to work on a shared vision.

In sum, this study highlights the complexity of longitudinal modeling and measurement to examine the interplay between transformational leadership practices, organizational conditions, psychological states, and learning activities in school contexts (Geijsel et al., 2009; Oude Groote Beverborg Sleegers, & van Veen, 2015a, 2015b; Thoonen et al., 2012). This study extends earlier cross-sectional studies that have focused on the interplay of leadership, organizational conditions, and teachers' engagement in learning activities by assessing the reciprocal nature of the links between these concepts. We found some indications for reciprocity between the concepts but also that relations may differ over time (see also Feldhoff et al., 2016). Levels of information sharing, however, seem not to be driven by teachers' perceptions of goal interdependence. These findings suggest that the links between the concepts may be more differentiated over time than could have been foreseen based on cross-sectional research. We also

found indications for growth and increase in stability of vision building and goal interdependence. Most importantly, we found no indications for a decline in information sharing. Its high levels were stable, even despite the limited influence of vision building and goal interdependence in sustaining them. In the following and final section, we will give recommendations for future research.

Recommendations for future research

Future research needs to validate and expand the conceptual model of our study in greater samples and different context (VET, secondary and primary schools). The greatest challenge lies in using longitudinal designs with more measurement occasions (density) and measurement instruments that are more sensitive to differences between the individual and team level. Helpful in this regard would be to have a theory from which to derive the expected rate of change of the concepts and their relations to determine the appropriate time intervals between measurements.

Modeling constructs at both the individual and the team level with multilevel models allows assessment of upward and downward forms of cross-level interactions. This may contribute to a deeper understanding of how leadership practices such as vision building or team characteristics such as diversity (e.g., van Knippenberg et al., 2004) have differential effects on teacher learning and goal interdependencies. Moreover, assessing the possible reciprocal relations between information sharing, goal interdependence, and vision building at the team level may give more insights into interventions at the individual and team level to enhance teacher learning in the school context, to improve teacher practices, and, in turn, student learning. Further work is needed to investigate how social learning as a form of critical reflection constitutes both individual and shared sensemaking and, as such, enhances teachers' participation in professional learning communities as discussed in the literature (Decuyper et al, 2010; K. McArdle & Coutts, 2010).

A further recommendation relates to the nature of the measurements to assess change. For example, the findings showed that information sharing did not grow or decline: Teachers' levels of discussing work-related issues and asking for feedback and advice appeared to be robust to changes over the 3-year period, using yearly intervals as measured in our study. More variation might be found using denser, and more contextualized, measurements, or by focusing on the content that is actually exchanged in relation to the type and the duration of the goals that are pursued (e.g., Gabelica et al., 2014). New challenges in specific situations may, for instance, cause temporal fluctuations in teachers' levels of information sharing. Such fluctuations can be captured longitudinally by measuring at more occasions with appropriate time intervals between them. By measuring on too few occasions and with too large intervals, these temporal fluctuations and challenges cannot be captured. Denser and more contextualized measurements may also shed more light on the reciprocal relations between information sharing, goal interdependence, and vision building, especially because the strengths of these relations (also the absent ones) differ over time (see also Coman et al., 2014; Eschleman & LaHuis, 2014; Orton & Weick, 1990). This could mean that information sharing could influence goal interdependence and vision building, but only temporarily. To better understand how the relations between a purposeful environment and social learning activities develop, further work is needed that is more sensitive to the concrete situational challenges teachers are

facing. This research should include more measurement occasions with shorter intervals and capture temporal challenges, for instance, by using open questions (e.g., Feldhoff et al., 2016; Sammons et al., 2014).

Notes

1. The missings that are relevant for this study are the missings on time points. Additionally, not all teachers within their teams responded.
2. Many researchers base the interpretation of fit measures on the article from Hu and Bentler (1999), and consider the following values acceptable: a chi-square ($X^2(df)$) that is not significant, an RMSEA $\leq .06$, a CFI $> .95$, and an SRMR $\leq .08$. Note, however, that these cutoff criteria are to be seen as guidelines that appear to be best applicable for comparing nested models. These values are neither absolute rules nor rules of thumb, and may even be too strict in some cases (Hu & Bentler, 1999; Marsh et al., 2004). For instance, with a sample size larger than 400, X^2 will almost always reach significance (Kenny, 2015), and experiential evidence suggests that path models with multiple factors that are based on a solid number of items will have unacceptable CFI and RSMEA measures in comparison to the criteria (Marsh et al., 2004, 2005). Accordingly, acceptable fit measures could be obtained by returning to simpler models (e.g., by reducing the sample size, the amount of factors, or the amount of items), but such actions would then undermine the validity of the study otherwise. Therefore, the plausibility of the model will have to be assessed with different criteria (see also Byrne, 2001). Instead of values meeting some externally imposed standard, the idea that progress over studies in fit values that are obtained from similar studies represents development seems to be more important, as proposed by different scholars (Bollen, 1989; Marsh et al., 2004).
3. In comparison, a longitudinal study, conducted in the same context, that assessed similar concepts and instruments reported the following fit measures for the measurement model: $X^2(2977) = 6055.275$ ($p = 0.000$), RMSEA = 0.040, CFI = 0.838, SRMR = 0.073 (Oude Groote Beverborg, Sleegers, Endedijk, & van Veen, 2015a).
4. Note that three conditions need to be met in order to infer causality: that cause and effect are related, that the effect follows the cause in time, and that other competing explanations therefore can be ruled out (Eschleman & LaHuis, 2014; Popper, 1959). This longitudinal study meets the first two conditions, but it does not meet the third.
5. Three ΔX^2 tests indicated that a model with invariant autoregressions of information sharing did not worsen the fit to the data as compared to the full model, but that the models with invariant autoregressions of goal interdependence and vision building, respectively, did worsen the fit to the data as compared to the full model. Moreover, because each pair of cross-lagged regressions differed substantially over time, we reckoned that further invariance tests would provide invalid results.
6. We considered the adequacy of the procedure by examining whether following another procedure, in which we restrained each of the pairs of cross-lagged regressions in the full model in separate tests, would lead to different results. We tested six models, which each had the cross-lagged regressions from one construct to one other set to 0, against the full CLP model: no cross-lagged regressions from vision building to goal interdependence ($\Delta X^2(2) = 4.634$, $p = .099$) and information sharing ($\Delta X^2(2) = 15.212$, $p = .000$), from goal interdependence to vision building ($\Delta X^2(2) = 6.099$, $p = .047$) and information sharing ($\Delta X^2(2) = 0.219$, $p = .896$), and from information sharing to vision building ($\Delta X^2(2) = 0.416$, $p = .812$) and goal interdependence ($\Delta X^2(2) = 3.770$, $p = .152$). Then, we combined the results thereof in a new restrained model and tested that against the full CLP model ($\Delta X^2(8) = 7.615$, $p = .472$). Then, we trimmed the restrained model by removing the cross-lagged regressions that were nonsignificant to create a parsimonious model and tested that against the restrained model ($\Delta X^2(8) = 15.852$, $p = .000$). The series of ΔX^2 tests indicated that the model that fitted best to the data was the restrained model ($X^2(723) = 1478.407$, $p = .000$; RMSEA = .040; CFI = .915; SRMR = .065). This model had two couples of cross-lagged regressions with one regression

being significant and the other nonsignificant within each couple ($\beta_{Vision1\rightarrow Info2} = 0.131$, $p = .000$; $\beta_{Vision2\rightarrow Info3} = -0.030$, $p = .573$; $\beta_{Goal1\rightarrow Vision2} = 0.175$, $p = .012$; $\beta_{Goal2\rightarrow Vision3} = 0.070$, $p = .350$). Notably, the mean of goal interdependence was marginally significant in this model ($\mu_{goal1} = -0.223$, $p = .060$). As such, this procedure also yielded a model with four cross-lagged regressions, but only between two constructs, and two of those regressions were non-significant. Because of the unclarity of the results of this procedure, we preferred to present and discuss the results from the parsimonious model that was directly derived from the full model.

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Notes on contributors

Arnoud Oude Groote Beverborg works as a post-doc at the Department of Educational Research and the Centre for School Effectiveness and School Improvement of the Johannes Gutenberg-University Mainz. His work concentrates on longitudinal and reciprocal relations between psychological factors, workplace conditions, and leadership, for sustained engagement in professional learning. Additional to his interest in enhancing school change capacity, he is developing dynamic conceptualizations and operationalizations of workplace and organizational learning, and he explores the application of dynamic systems modeling techniques for school contexts.

Peter Sleegers is a senior researcher and consultant at BMC Consultancy. He has published extensively on leadership, innovation, and educational policy in different high-impact journals and several edited books in the field of educational administration and school improvement. Current projects are design studies into professional learning communities and student learning, and longitudinal research on building school-wide capacity for sustained school improvement.

Nienke Moolenaar is a faculty member at the Department of Education at Utrecht University, the Netherlands. In her research, she explores how educators' social networks change during educational reform. Drawing on complexity theory and literature on dynamic systems, she aims to understand how this network change supports and constrains school improvement in terms of teachers' instructional practice and student achievement.

Klaas van Veen is professor in educational studies at the University of Groningen and director of the teacher education program. His research concerns the pedagogy of how to organize teacher learning in the context of secondary and higher education.

ORCID

Arnoud Oude Groote Beverborg http://orcid.org/0000-0002-6370-2902

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Appendix 1. Response rates & sample descriptives

Table A1.1. Response rates of Time Points 1, 2, and 3.

Questionnaires:	t1	t2	t3
Send	853	857	822
Returned	454	449	389
Response rate	53%	52%	47%
Dropped	−16	−87	−65
Unique responses on time points:			
Occasions 1&2&3		144	
Occasions 1&2 or 1&3 or 2&3	82	45	54
Occasion 1 or 2 or 3	167	82	81
Total unique responses in the data set		655	

Note: cases could be dropped, for instance, because not all returned questionnaires were filled out completely.

Table A1.2. Sample descriptives of Time Points 1, 2, and 3.

		t1	t2	t3
Gender (men)		66%	68%	60%
Age (years)	*M*	48	48	48
	SD	9	10	10
	Min	22	20	21
	Max	62	63	65
Job size	> 32 hr	61%	62%	58%
Tenure	> 20 years	33%	32%	32%
	10 years	20%	22%	22%
	< ½ year	4%	2%	0%
Education	Master	16%	16%	14%
	Bachelor	72%	74%	79%
	2nd education	12%	10%	7%

Note: Years and percentages have been rounded.

Appendix 2. Tests of invariance in the measurement model

		$\Delta X^2(df)$
Factor loadings λ	unequal – equal	12.969(20)
Item intercepts θ	unequal – equal	19.022(20)

Note: $\Delta X^2(df)$ = chi-square difference test with degrees of freedom in parentheses. The restricted models are indicated by "equal" in the second column. A significant ΔX^2 test indicates a worsening of fit through restrictions. Thus, significance indicates that the unrestricted model (indicated by "unequal"), that is, the one with more free parameters and thus a lower degree of freedom should be reverted to, and vice versa. The nonsignificances of the tests indicates that the measurement model with strong factorial invariance should be chosen.

Appendix 3. Item formulations and the scales' factor structures in the measurement model

All scales were responded to as follows: (1) disagree much, (2) partially disagree, (3) do not disagree, do not agree, (4) partially agree, (5) agree much.

Table A3.1. Transformational leadership: vision building.

My leader …	Invariant factor loadings λ	Invariant intercepts θ	Residual variances ψ^2 t1	t2	t3
… uses all possible occasions to share the vision of the department with the team, students, parents, and others	1.000	3.347	0.467	0.409	0.397
… refers during decision-making processes explicitly to the goals of the department	1.024	3.332	0.312	0.364	0.277
… clarifies for the team the relation between the vision of the department and initiatives from the board of directors	1.099	3.140	0.277	0.308	0.270
… clearly describes current problems in light of a vision of the future of the department	1.214	3.269	0.259	0.274	0.170
… sketches the consequences of a vision for the department's current ins and outs during meetings	1.161	3.320	0.226	0.272	0.236

Note: Refers to the development of shared vision, goals, and priorities (Geijsel et al., 2009).

Table A3.2. Goal interdependence.

	Invariant factor loadings λ	Invariant intercepts θ	Residual variances ψ^2 t1	t2	t3
In our team, we all want to reach the same	1.000	3.329	0.564	0.443	0.489
We agree on what quality is for our team	1.163	3.410	0.355	0.348	0.388
If work does not satisfy quality requirements, the responsible team member is asked about this by other team members	0.962	3.002	0.736	0.659	0.600

Note: Refers to the degree to which coordination and interaction is required to reach a team member's own goals as well as the goals of other team members (Runhaar, 2008; van der Vegt et al., 2000).

Table A3.3. Information sharing.

	Invariant factor loadings λ	Invariant intercepts θ	Residual variances ψ^2 t1	t2	t3
If I think that I have not done my work well, I discuss this with my team members	1.022	3.695	0.383	0.396	0.350
I regularly ask my team members for feedback	0.954	3.841	0.438	0.377	0.368
I discuss what I find important in my work with team members	1.000	4.034	0.281	0.264	0.229
I discuss our criteria for good functioning with team members	0.985	3.659	0.512	0.422	0.452
I discuss problems encountered in my teaching practice with others in order to learn from their responses	0.998	4.043	0.303	0.291	0.273

Note: Refers to the seeking of information and advice from each other (Geijsel et al., 2009; Runhaar, 2008; van Woerkom, 2003).

Appendix 4. Means, standard deviations, and correlations from the measurement model

Factors	Absolute mean	Relative mean	*SD*	1	2	3	4	5	6	7	8
1. Vision [1]	3.229	−0.083*	0.918								
2. Vision [2]	3.327	@0	0.755	.339**							
3. Vision [3]	3.338	0.010	0.831	.381**	.400**						
4. Goal [1]	3.227	−0.087*	0.773	.285**	.208**	.168**					
5. Goal [2]	3.326	@0	0.736	.206**	.193**	.151**	.331**				
6. Goal [3]	3.307	−0.019	0.732	.185**	.209**	.236**	.357**	.431**			
7. Info [1]	4.050	0.018	0.619	.177**	.089**	.072*	.199**	.107**	.074*		
8. Info [2]	4.032	@0	0.559	.230**	.151**	.114**	.158**	.175**	.107**	.251**	
9. Info [3]	4.037	0.005	0.596	.178**	.111**	.143**	.142**	.146**	.181**	.250**	.220**

Note: Vision = transformational leadership vision building; Goal = goal interdependence; Info = information sharing; [1], [2], [3] indicate Time Points 1, 2, 3, respectively. Absolute means indicates that item intercepts were set to 0 to obtain absolute factor means from the model. Relative means indicates that the factor means were estimated with the item intercepts set to be invariant over time. The correlation and standard deviation values were estimated with relative means. @0 indicates that this mean was set to 0 at this time point in order to estimate the means at the other time points.

**$p < .01$. *$p < .05$.