Departmental PLCs in secondary schools: The importance of transformational leadership, teacher autonomy, and teachers' self-efficacy

Professional learning communities (PLCs) are considered ideal contexts for teachers' professional development and school improvement. Therefore, it is necessary to explore the interplay between PLC characteristics (i.e. collective responsibility, reflective dialogue, and deprivatized practice) in secondary school departments, and understand what variables (i.e. transformational leadership by the principal, teacher autonomy, and teachers' self-efficacy) stimulate these PLC characteristics. Data was collected from 324 Mathematics, French, and General Studies teachers in 80 departments of 33 Flemish secondary schools. The results of a path analysis show that teachers' collective responsibility and self-efficacy are positively related to their reflective dialogue. Furthermore, the relationship between transformational leadership by the principal and reflective dialogue is fully mediated by collective responsibility. Finally, the relationship between teacher autonomy and reflective dialogue is fully mediated by teachers' self-efficacy.

Keywords: departments; professional learning communities (PLCs); transformational leadership; teacher autonomy; teachers' self-efficacy

Introduction

The teaching profession has become progressively complex, with increasing demands and expectations being placed on teachers (Wei et al., 2009). Consequently, international researchers are urging teachers to participate in professional learning communities (PLCs) (McLaughlin and Talbert, 2001; Stoll et al., 2006). In these communities, teachers can learn from and with each other by sharing experiences and practices, and engaging in reflective interactions (Stoll et al., 2006). As a result, PLCs are seen as promising contexts for improving

students' learning, teachers' teaching, and teachers' professional development in schools (Stoll et al., 2006; Wei et al., 2009). They therefore improve the school itself (Stoll et al., 2006).

Secondary schools are large organisations in which several PLCs can be active. Previous studies on PLCs (e.g. Lomos, Hofman, and Bosker, 2011) have focused on school-wide or department-based PLCs. The latter approach is most commonly used in studies on PLCs in secondary schools (Lomos, Hofman, and Bosker, 2011). More specifically, secondary schools are often divided into separate departments, based on the teachers' subject. As such, these departments form the most important units for organising and regulating teachers' behaviour in secondary schools (Visscher and Witziers, 2004). Furthermore, teachers describe their department as more than an administrative unit. They describe it as contexts that have potential for exchanging experiences and practices (Brown, Rutherford, and Boyle, 2000; Melville and Wallace, 2007). Moreover, teachers involved in the same subjects are more likely to interact as they have more in common, such as mutual interests that focus on several elements of the teaching job; educational goals, teaching methods and strategies; student evaluation; and their own professional development (Huberman, 1993; Little, 2002; McLaughlin and Talbert, 2001). Hence, PLCs are conceptualised and operationalised in this study at the department level as departmental PLCs. However, according to Verbiest (2008), questions regarding the importance of departmental PLCs and the ways in which departmental PLCs in secondary schools can be developed have not yet been answered. We believe that breaking down the PLC concept into clear and identifiable characteristics can be useful for theory and practice, and can provide information about the interrelationships between PLC characteristics and how they can be encouraged (Lomos, 2012; Sleegers et al., 2013; Stoll et al., 2006). The present study will consider PLC characteristics as separate variables, distinguishing between (1) the presence of certain norms and beliefs in PLCs, and (2) collaborative activities in PLCs (Bryk, Camburn,

and Louis, 1999).

Teachers' participation in PLCs does not take place in a vacuum. A review study conducted by Stoll et al. (2006) shows that both the school context and individual teacher characteristics can foster or impede PLCs. In the school context, principal leadership (e.g. Bryk, Camburn, and Louis, 1999) and teacher autonomy (e.g. Canrinus et al., 2011; Skaalvik and Skaalvik, 2009) are found to be important factors at the school level. At the individual teacher level, self-efficacy is found to be positively related to collaboration (e.g. Tschannen-Moran and Hoy, 2001). Although these variables have already been found as important for PLCs, to our knowledge, no previous studies have examined the combination of these variables. To fill this research gap, the goal of this study is to examine the interplay between factors at the school level (i.e. principal leadership and teacher autonomy) and the teacher level (i.e. self-efficacy) influencing PLCs. The Job Demands-Resources (JD-R) model (Bakker and Demerouti, 2007) provides a useful framework for the construction of the theoretical model below.

Theoretical framework

The construction of the theoretical model, including the interplay of factors at the school level (i.e. principal leadership and teacher autonomy) and the teacher level (i.e. self-efficacy) is based on the JD-R model (Bakker and Demerouti, 2007). The JD-R model (Bakker and Demerouti, 2007) has revealed that job resources and personal resources are able to foster a motivational process leading to teacher learning (Bakker and Demerouti, 2007). These job resources include relatedness, support and autonomy. In the present study, the first job resource of relatedness is operationalised in participation in PLCs, actualised through collaboration and shared work with colleagues (Deci and Ryan, 2000). The second job resource of support is operationalised in transformational leadership by the principal. This is a crucial leadership style, consisting of elements such as individualised support of the professional development and self-efficacy of

teachers (e.g. Geijsel et al., 2009; Nguni, Sleegers, and Denessen, 2006), and building a collaborative culture (Bryk, Camburn, and Louis, 1999; Day, Gu, and Sammons, 2016; Leithwood, Leonard, and Sharratt, 1998; Youngs and King, 2002). Examining the interplay of these factors may reveal the role of the principal in influencing PLCs in a direct and indirect way. The third job resource of autonomy is operationalised in teacher autonomy or the need of teachers to feel in control and to self-direct their own professional development (self-efficacy) (Bandura, 1997; Ryan and Deci, 2000). In this way, teachers feel more involved in collective learning processes (Bakker, Demerouti, and Schaufeli, 2003; Bakker, Demerouti, and Verbeke, 2004; Canrinus et al., 2011; Skaalvik and Skaalvik, 2009). Additionally, the JD-R model determines the mediating role of personal resources (Xanthopoulou et al., 2007). This is operationalised in teachers' self-efficacy as one of the most important psychological teacher characteristics that influences teacher behaviour (Tschannen-Moran and Hoy, 2001). In sum, the current study includes school context factors operationalised in transformational leadership and teacher autonomy that influence the individual teacher characteristic of self-efficacy and, in turn, influence PLC characteristics in departments. In the following paragraphs, the key variables of the present study are further discussed. In particular, PLC characteristics as outcome variables are presented, followed by job resources operationalised as two variables at the school level (i.e. transformational leadership by the principal and teacher autonomy), and a discussion of one personal resource operationalised in teachers' self-efficacy as a variable at the teacher level.

PLC characteristics

Over the past decades, the research interest in the concept of PLCs has grown tremendously (e.g. Lomos, Hofman, and Bosker, 2011, Sleegers et al., 2013; Vangrieken et al., 2015; Vescio, Ross, and Adams, 2008). However, studies on PLCs differ significantly in terms of how they

conceptualise PLCs (Sleegers et al., 2013). In their review study, Stoll et al. (2006) stated that there is no international definition of PLCs. Nevertheless, there is international consensus that a PLC is a group of people (i.e. teachers) who share and critically question their teaching practice in an ingoing, reflective, collaborative, and inclusive, learning- and growth-oriented way. This means that teachers in a school or department continuously seek and share learning, and act on their learning work for the students' benefit (Stoll et al., 2006). However, a PLC remains an umbrella concept (Vangrieken et al., 2015). The first conceptualisations of PLCs originates from the 1980s. PLCs were than operationalised as a one-dimensional concept to capture a sense of community. Thereafter, the multidimensional perspective became dominant (Lomos, Hofman, and Bosker, 2011; Stoll et al., 2006). In the vast majority of studies, the interpersonal dimension of PLCs appears to be central to their definition (Bolam et al., 2005; Sleegers et al., 2013; Stoll et al., 2006). The interpersonal dimension refers to the capacity of teachers to learn together and collaborate, based on shared conceptions of learning, instruction and education, to construct, reconstruct and apply knowledge as a team (Sleegers et al., 2013; Verbiest, 2008). In this dimension, a distinction is made between (1) *mental characteristics*, the conditions necessary to support collaboration in PLCs (Stoll et al., 2006), and (2) *behavioural characteristics*, the collaborative activities in PLCs that are important for teachers' professional behaviour (Stoll et al., 2006).

Mental characteristics

For mental characteristics, a distinction can be made between 'collective responsibility' and 'shared values and vision'. Collective responsibility for student learning concerns discussing how teachers' instruction can stimulate students' intellectual growth and development (Louis, Marks, and Kruse, 1996). Teachers in PLCs have a collective responsibility for all students' learning within a school or department (Wahlstrom and Louis, 2008). Some researchers also

identify shared values and vision as a mental characteristic. However, some define shared values and vision as a supportive leadership condition rather than a PLC characteristic (Fullan, 2015; Senge, 2006). Furthermore, others state that shared values and vision overlap with collective responsibility, and should not be considered as a separate PLC characteristic (Lomos, Hofman, and Bosker, 2011; Wahlstrom and Louis, 2008). Moreover, the validation study conducted by Lomos, Hofman, and Bosker (2011) on the measurement of PLCs and their characteristics raises concerns about shared values and vision. Shared values and vision contain aspects of the role of the principal and refer to a supportive practice rather than a PLC characteristic. Consequently, this study focuses solely on collective responsibility as the mental characteristic of a PLC.

Behavioural characteristics

For behavioural characteristics, 'reflective dialogue' and 'deprivatized practice' are distinguished (Wahlstrom and Louis, 2008). Reflective dialogue refers to teachers' in-depth conversations with other PLC members about educational issues, such as curriculum, instruction, and student learning (Louis, Marks, and Kruse, 1996; Stoll et al., 2006; Wahlstrom and Louis, 2008). These conversations can lead to new ideas and help teachers to reflect on and develop their teaching practice (Louis, Marks, and Kruse, 1996; Stoll et al., 2006; Wahlstrom and Louis, 2008). Deprivatized practice relates to teachers openly sharing their teaching practice, for example, by observing each other's classroom practice, trading roles of mentor, advisor or specialist, and giving and receiving feedback (Louis, Marks, and Kruse, 1996; Stoll et al., 2006; Wahlstrom and Louis, 2008).

In short, earlier theoretical work regarding interpersonal PLC characteristics distinguished conceptually between mental and behavioural characteristics and assumed that the mental characteristics steer the behavioural characteristics (Bryk, Camburn, and Louis, 1999; Verbiest,

2012). However, there is a lack of empirical research on the relationship between the mental and behavioural characteristics. Therefore, the first aim of this study is to explore the relationships between collective responsibility as a mental characteristic, and reflective dialogue and deprivatized practice as behavioural characteristics of PLCs.

Variables related to PLCs

Previous research (e.g. De Neve and Devos, 2016; Geijsel et al., 2009; Kwakman, 2003; Vanblaere and Devos, 2016) studied a number of variables related to PLCs. In this respect, school context factors (i.e. transformational leadership by the principal and teacher autonomy) and individual teacher characteristics (i.e. teachers' self-efficacy) prove to be important (Stoll et al., 2006; Verbiest, 2008). Transformational leadership by the principal can be considered as a lever for team building among teachers, whereby teachers are encouraged to share ideas and exchange practices while implementing the school vision (e.g. Bryk, Camburn, and Louis, 1999). Alternatively, the school context can be characterised by a work environment that provides autonomy to teachers. Here, teachers are stimulated to work independently and learn through their own individual practice (e.g. Clement and Vandenberghe, 2000). This study examines how the combination of transformational leadership by the principal and teacher autonomy influences interpersonal PLC characteristics. Moreover, teachers' self-efficacy is considered as an important psychological variable related to professional learning (e.g. Geijsel et al., 2009; Xanthopoulou et al., 2007). Indeed, research indicates that transformational leadership practices are strongly mediated by self-efficacy (Geijsel et al., 2009; Runhaar, Sanders, and Yang, 2010). Transformational leadership by the principal can influence teachers' belief in their capacities and prompt them to be open to their colleagues. Self-efficacy is also influenced by teachers' perception of their autonomy in schools. When teachers feel limited in what they do, their self-efficacy is negatively affected (Skaalvik and Skaalvik, 2010).

Therefore, transformational leadership by the principal, teacher autonomy, and teachers' self-efficacy are included in this study as variables related to PLCs.

Transformational leadership by the principal

Several studies state that leadership by the principal is key to developing and improving PLCs in schools (Bryk, Camburn, and Louis, 1999; Youngs and King, 2002). According to Stoll et al. (2006) and Engels et al. (2008), principals can create conditions for the development of a school culture to encourage teaching and learning. Consequently, they have a strong influence on teachers and their teaching practice (De Neve and Devos, 2016; Stoll et al., 2006; Vanblaere and Devos, 2016). Transformational leadership is a strategy that focuses on how leaders influence their staff by connecting individuals (Leithwood, 1992). These leaders inspire and motivate teachers to improve the quality of education (Hallinger, 2003). Transformational leadership by the principal has been related to PLCs in previous studies (e.g. Minckler, 2014; Pounder, 1999). For instance, the more teachers perceive their principal as a transformational leader, the more they ask each other for feedback (Runhaar, Sanders, and Yang, 2010). Furthermore, Minckler (2014) states that transformational leadership by the principal in secondary schools increases teacher collaboration and community identity. Principals with a transformational leadership style allocate time for teachers to meet, provide opportunities for professional development (Youngs and King, 2002), reduce teacher isolation, and increase teachers' commitment to PLCs (Pounder, 1999).

In summary, it seems questionable that PLCs can be developed and improved within a school without strong transformational leadership by the principal (Bryk, Camburn, and Louis, 1999). Accordingly, the second aim of this study is to explore the relationship between transformational leadership by the principal and interpersonal PLC characteristics.

Teacher autonomy

Besides teacher collaboration, teachers value teacher autonomy as an important workplace condition that affects their professional status (Pearson and Moomaw, 2005). As such, in this study, teacher autonomy refers to 'the space that teachers receive from their school to determine their own professional development and teaching practice' (Hoekstra et al., 2009). At the same time, schools has to provide opportunities for teacher collaboration and teacher autonomy to connect teachers as a professional team (Canrinus et al., 2011). In the past however, teacher autonomy was mainly understood as a negative conceptualisation of independence and individualism (Hargreaves, 1993), excluding collaboration by definition (Vangrieken et al., 2017). Nevertheless, the understanding of teacher autonomy as equal to individualism becomes unusable in an environment characterised by an increasing significance of teacher collaboration. Furthermore, the relevance of PLCs in schools does not have to eliminate the importance of teacher autonomy or vice versa (Toole and Louis, 2002). Nowadays, teacher autonomy has a more positive connotation, which includes personal choice, collaborative decision-making and the freedom to make professional choices (Vangrieken et al., 2017). For instance, Clement and Vandenberghe (2000) found a new form of teacher autonomy, which is described as a team recognising the importance of the autonomy of a certain teacher to work on particular tasks. This underlines the close, but complex relationship between teacher collaboration or teacher participation in PLCs and teacher autonomy (Clement and Vandenberghe, 2000). Therefore, teacher participation in PLCs and teacher autonomy are not contradictory, but complementary (Clement and Vandenberghe, 2000; Huberman, 1993).

Since Clement and Vandenberghe (2000) found that a healthy balance between teacher autonomy and collaboration (i.e. through participation in PLCs) is pivotal, it is not possible or desirable to disengage one from the other. In this regard, schools should motivate teachers to

participate in PLCs while simultaneously providing teachers with autonomy. Therefore, this study will examine the relationship between teacher autonomy and interpersonal PLC characteristics.

Teachers' self-efficacy

Self-efficacy is an important individual characteristic. It refers to a cognitive process in which people construct beliefs about their own capabilities to achieve desired outcomes, and it determines how people feel, think, behave, and motivate themselves (Bandura, 1978, 1997). A teacher's self-efficacy is defined as "a judgement of his or her capabilities to bring about desired outcomes of student engagement and learning, even among those students who may be difficult or unmotivated" (Tschannen-Moran and Hoy, 2001, 684). Several studies examined the relationship between teachers' self-efficacy and their collaborative behaviour. For example, when teachers engage in professional learning activities or collaboration that includes conversation about values and beliefs, they risk conflict and differences in opinion or receiving feedback which might disconfirm their positive self-efficacy (Johnson, 2003). However, if teachers gain sufficient support from their team, they will feel competent in meeting new challenges and engage more easily in professional learning activities (Oude Groote Beverborg, Sleegers, and van Veen, 2015). Moreover, several studies found a positive relationship between teachers' self-efficacy and their willingness to collaborate with colleagues (da Costa and Riordan, 1996; Wahlstrom and Louis, 2008). However, further examination of how a sense of efficacy can support or inhibit teachers' willingness to share their experiences and teaching practice is necessary.

Bandura (1978, 1997) and Xanthopoulou et al. (2007) suggest that teachers' self-efficacy may function as a mediator in the relationship between school context factors (i.e. transformational leadership by the principal and teacher autonomy) and behavioural outcomes (i.e. collaborative

behaviour) (Bandura, 1978, 1997). More specifically, the impact of transformational leadership practices and workplace conditions, such as teacher autonomy, on teachers' professional learning (i.e. via participation in PLCs) appears to be mediated by teachers' self-efficacy (Geijsel et al., 2009; Kwakman, 2003).

Consequently, the present study examines the interplay between the school context and a psychological teacher characteristic by testing teachers' self-efficacy as a mediating variable between transformational leadership by the principal and teacher autonomy, and interpersonal PLC characteristics.

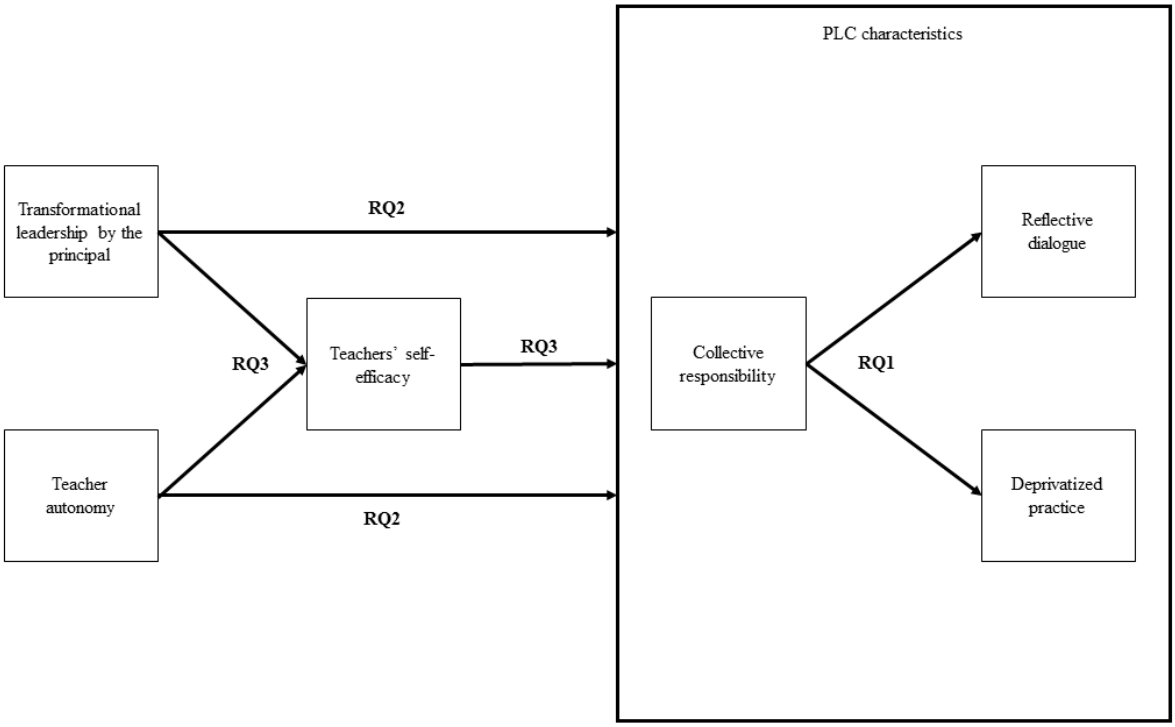
The theoretical model of the relationships between these variables is presented in Figure 1.

Research aim and questions

Given the potential of PLCs to improve students' learning, teachers' teaching, teachers' professional development, and therefore the whole school (Wei et al., 2009), the aim of this study is twofold. First, this study examines the relationships between interpersonal PLC characteristics (i.e. collective responsibility, reflective dialogue, and deprivatized practice). Research on the interrelatedness of these interpersonal PLC characteristics has generally been conducted through small-scale qualitative studies (e.g. De Neve and Devos, 2017; Vanblaere, 2016). Large-scale quantitative studies that confirm the interplay between these interpersonal PLC characteristics are therefore needed (Bryk, Camburn, and Louis, 1999; Hargreaves, 2007). Second, this study aims to enhance our understanding of how certain school context and teacher factors (i.e. transformational leadership by the principal, teacher autonomy, and teachers' self-efficacy) can facilitate the development and improvement of interpersonal PLC characteristics (i.e. collective responsibility, reflective dialogue, and deprivatized practice) (Stoll et al., 2006). The following research questions are addressed:

- **RQ1:** How is collective responsibility as a mental characteristic of PLCs related to reflective dialogue and deprivatized practice as behavioural characteristics of PLCs?
- **RQ2**: How are transformational leadership by the principal and teacher autonomy as school context factors related to collective responsibility, reflective dialogue, and deprivatized practice as interpersonal characteristics of PLCs?
- **RQ3**: How are transformational leadership by the principal and teacher autonomy as school context factors indirectly related to collective responsibility, reflective dialogue, and deprivatized practice as interpersonal characteristics of PLCs via teachers' self-efficacy?

Figure 1: Theoretical model.



Methodology

A path analysis based on data from an online teacher survey was conducted to investigate the research questions. In path analysis, a hypothesised model of relationships between variables is tested statistically to determine the extent to which it is consistent with the data (Muthén and Muthén, 1998-2017).

Sample

Data from an online teacher survey was collected from 324 teachers of Mathematics, French, and General Studies[1] in 80 departments of 33 secondary schools in Flanders (Belgium). The sample included 267 (82.4%) female and 57 (17.6%) male teachers. This sample is representative of the Flemish (Belgian) educational context (Departement Onderwijs en

Vorming, 2016). The sample comprised 149 Mathematics teachers (46.0%), 137 French teachers (42.3%), and 38 teachers of General Studies (11.7%). The average teaching experience was 15.31 years (*SD*=9.88), varying from one year to 41 years.

Measures

The central concepts of this study are operationalised and measured using validated scales. These are discussed in more detail below. Confirmatory factor analyses were performed and the following fit indices were evaluated: the *χ2 test*, the *χ2/df ratio*, the *comparative fit index* (*CFI*), the *Tucker-Lewis index* (*TLI*), the *root mean square error of approximation* (*RMSEA*), and the *standardised root mean square residual* (*SRMR*). According to Hu and Bentler (1999), the *χ2 test* assesses the degree of fit between the hypothesised model and the data. This test statistic has to be non-significant. However, because of its sensitivity to sample size, it is almost always significant when you have large samples (Muthén and Muthén, 1998-2017). Next, the *χ2/df ratio* was assessed. A value of ≤2 demonstrates a good fit, and a value of ≤3 determines an acceptable fit (Schermelleh-Engel, Moosbrugger, and Müller, 2003). Furthermore, models with *RMSEA* and *SRMR* <.06, and *TLI* and *CFI* >.95 indicate a good fit. Models with *RMSEA* and *SRMR* <.08, and *TLI* and *CFI* >.90 demonstrate an adequate fit (Hu and Bentler, 1999).

Interpersonal PLC characteristics

To measure the interpersonal PLC characteristics, subscales of the Teachers' Professional Community Index of Wahlstrom and Louis (2008) were used. These subscales measure three interpersonal PLC characteristics: collective responsibility, reflective dialogue, and deprivatized practice. They were adapted and translated for the Flemish context by Vanblaere and Devos (2017). Collective responsibility is measured with three items (e.g. "Teachers in my department feel responsible for helping each other to improve their instruction"). Reflective

dialogue is measured with five items (e.g. “How often in this school year have you had conversations with colleagues from your department about what helps students to learn best?”). Deprivatized practice is measured with three items (e.g. “How often in this school year have colleagues from your department observed your class?”). All items are scored on a five-point Likert scale. The subscale of collective responsibility ranges from 1 (strongly disagree) to 5 (strongly agree). For reflective dialogue and deprivatized practice, the subscales range from 1 (never) to 5 (very often). Reliability analyses indicate that the subscales of collective responsibility (α=.73), reflective dialogue (α=.79), and deprivatized practice (α=.70) are reliable. The goodness-of-fit estimates are χ^2=89.475, *df*=40, *p*<.001; χ^2/df *ratio*=2.24; *CFI*=.947; *TLI*=.926; *RMSEA*=.062, with a *90% confidence interval* of .045-.079; and *SRMR*=.055, indicating an adequate fit.

Transformational leadership by the principal

Transformational leadership by the principal is measured using the supportive leadership function scale of Hulpia, Devos, and Rosseel (2009). This scale consists of 10 items (e.g. “My principal helps the teachers”), which are scored on a five-point Likert scale ranging from 1 (never) to 5 (always). The Cronbach’s alpha for this variable is .90. The goodness-of-fit indices indicate an acceptable fit: χ^2=80.685, *df*=34, *p*<.001; χ^2/df *ratio*=2.37; *CFI*=.960; *TLI*=.947; *RMSEA*=.065, with a *90% confidence interval* of .047-.084; and *SRMR*=.055.

Teacher autonomy

Teacher autonomy is measured using 11 items of the subscale general teaching autonomy from the teacher autonomy scale of Pearson and Moomaw (2006) (e.g. “I have the freedom to be creative in how I teach my lessons”). This scale is scored on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The Cronbach’s alpha is .73, which indicates

a reliable construct; the scale also has a satisfactory fit: χ^2=72.506, *df*=41, *p*=.002; χ^2/df *ratio*=1.77; *CFI*=.934; *TLI*=.912; *RMSEA*=.048, with a *90% confidence interval* of .030-.067; and *SRMR*=.048.

Teachers' self-efficacy

Teachers' self-efficacy is measured by means of the short version of the Ohio State Teacher Efficacy Scale (Tschannen-Moran and Hoy, 2001), which uses a five-point Likert scale ranging from 1 (not at all) to 5 (very well). The original scale consists of 12 items, three subscales (i.e. instructional strategies, classroom management, and student engagement), and one underlying factor, teachers' self-efficacy. Three items were deleted a priori, based on low factor loadings or items that are conceptually similar to other items in the scale (i.e. item 3, item 11, and item 20) (Tschannen-Moran and Hoy, 2001, 800). The remaining scale consists of nine items (e.g. "How much can you do to get children to follow classroom rules?"). Reliability tests indicate that this scale is reliable (α=.82), and the goodness-of-fit indices indicate an acceptable fit: χ^2=66.026, *df*=22, *p*<.001; χ^2/df *ratio*=3.00; *CFI*=.945; *TLI*=.910; *RMSEA*=.079, with a *90% confidence interval* of .057-.101; and *SRMR*=.046.

Control variables

This study controls for two demographic teacher variables: gender and teaching experience. Regarding gender, Bryk, Camburn, and Louis (1999) indicate that female teachers are more interested in dense patterns of informal communication at work and have lower preference for individualistic work settings. Gender (female, male) is a categorical variable. The first category is the reference category. Regarding teaching experience, Vanblaere and Devos (2015) state that teachers with more teaching experience score lower for interpersonal PLC characteristics. Teaching experience (number of years) is included as a continuous variable.

Data analysis

First, descriptive statistics and correlations for all the study variables were calculated. Second, this study considered two control variables. To facilitate model estimation, preliminary regression analyses for the control variables were performed. Only significant relationships at a .05 significance level between the control variables and the study variables were retained in the model. Third, the data was analysed via a path analysis. This study deals with complex data, as teachers are nested in departments. However, we cannot ignore the nested structure of our sample (teachers are nested in secondary school departments). Therefore, we performed a path analysis using Mplus, which allows us to take the clustered structure of our data into account, using the type=complex command in combination with a specification of the department cluster variable. With this approach, standard errors are computed and a chi-square test of the model fit takes into account the fact that observations are non-independent due to cluster sampling (Muthén and Muthén, 1998-2017). The need to address the clustering issue in the data is shown by the intraclass correlation coefficients (ICCs). The ICC is the proportion of the total variance explained by group membership. In educational contexts, ICC values of .10 are considered as medium and values of .15 as large (Hox, 2010). Deprivatized practice has an ICC value of .12. Both collective responsibility and reflective dialogue have an ICC value of .21. Ignoring the nested structure of the data would therefore lead to incorrect results. However, because our variables and relationships were all assessed at the individual level and our research questions did not address variability across departments, more complex multilevel analyses were not needed and were not applied here (Hox, 2010; Muthén and Muthén, 1998-2017; Stapleton, McNeish, and Yang, 2016). As the data was not normally distributed, the maximum-likelihood parameter estimates with standard errors and a Chi-square test statistic that are robust to non-normality and non-independence of observations were used (i.e. MLR). The model fit was

evaluated using the fit indices mentioned above (cf. Measures). All analyses were performed with the Mplus 7 software package (Muthén and Muthén, 1998-2017).

Results

Descriptive statistics and correlations

First, the descriptive statistics and correlations in Table 1 show that teachers feel collective responsibility for student learning in their department (*M*=3.82; *SD*=.65), and occasionally discuss educational issues with their department colleagues (*M*=3.28; *SD*=.69). However, the mean of deprivatized practice is very low (*M*=1.52 on a scale from 1 'never' to 5 'always'; *SD*=.59), which indicates that observing each other or helping each other to teach rarely or never happens. This is in line with the findings of Lomos (2012), who found that teachers in secondary schools rarely open the classroom door for observation. Moreover, Author et al. (2017b) and the TALIS report (Organisation for Economic Co-operation and Development (OECD), 2014) found that teachers in Flemish secondary schools rarely observe each other's teaching practice or provide feedback to each other. Furthermore, we investigated the frequency table and the box plot of deprivatized practice. Based on the low mean score of deprivatized practice and the results of the frequency table and the box plot that show that there are too few teachers who indicate that deprivatized practice takes place, the decision was made to remove deprivatized practice from further analyses. For transformational leadership by the principal (*M*=3.70; *SD*=.68), teacher autonomy (*M*=3.76; *SD*=.43), and teachers' self-efficacy (*M*=3.67; *SD*=.46), the means are rather high. This indicates that teachers perceive their principal as a leader who frequently exhibits transformational practices, that they experience freedom in their school, and that they strongly believe in their ability to achieve goals.

Table 1. Means (*M*), Standard Deviations (*SD*), and correlations (*n*=324).

	M	***SD***	**Range**	**1.**	**2.**	**3.**	**4.**	**5.**	**6.**
1. Collective responsibility	3.82	.65	1-5	-					
2. Reflective dialogue	3.28	.69	1-5	.437***	-				
3. Deprivatized practice	1.52	.59	1-5	.191***	.355***	-			
4. Transformational leadership	3.70	.68	1-5	.154**	.111*	.102*	-		
5. Teacher autonomy	3.76	.43	1-5	.082	.115*	-.071	.108*	-	
6. Teachers' self-efficacy	3.67	.46	1-5	.196***	.270***	.089	.057	.394***	-

*Note. * p<.05; ** p<.01; *** p<.001.*

Preliminary regression analyses

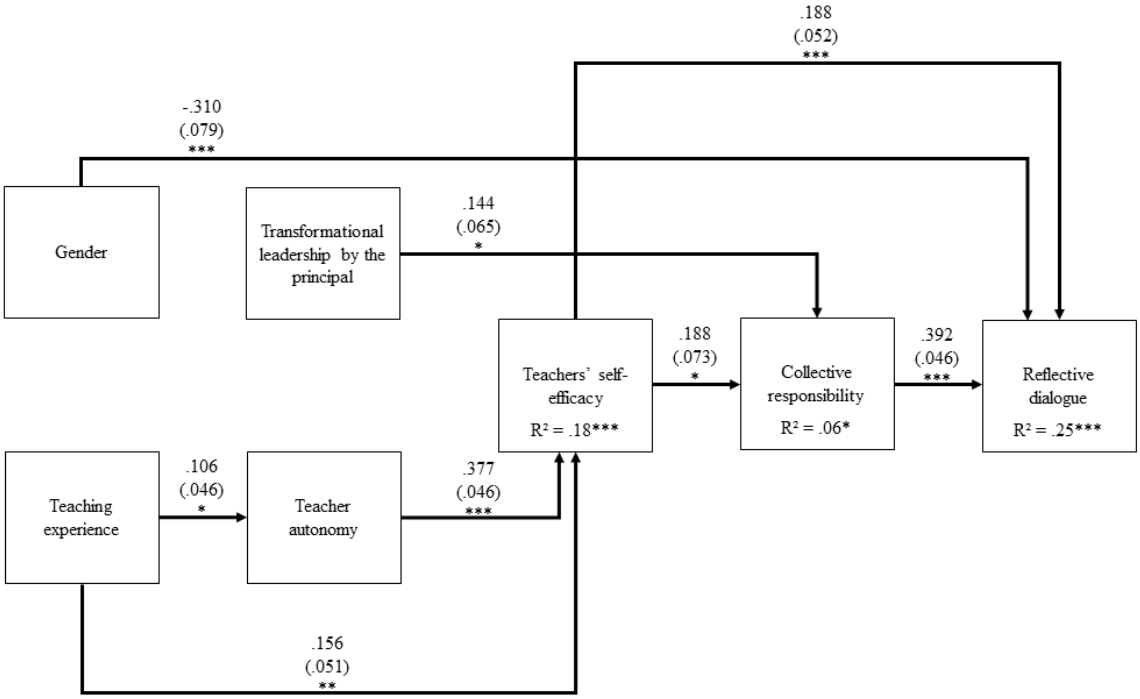
Based on preliminary regression analyses regarding the control variables, significant relationships at a .05 significance level between the control variables and the study variables were retained in the model: (1) the relationship between gender and reflective dialogue (β=-.359; *SE*=.098; p<.001); (2) the relationship between teaching experience and teachers' self-efficacy (β=.196; *SE*=.054; p<.001); and (3) the relationship between teaching experience and teacher autonomy (β=.106; *SE*=.046; p=.020).

Path analysis

The path analysis shows that the hypothesised model has a satisfactory fit to the data (χ^2=5.571, *df*=6, p=.438; χ^2/df *ratio*=.929; *CFI*=1.000; *TLI*=1.003; *RMSEA*=.000, with a *90% confidence interval* of .000-.071; and *SRMR*=.027). Next, individual relationships were evaluated using the critical ratio (CR). Non-significant CR relationships were removed one by one, starting with the highest p-value. The remaining models were run again because of the principle of parsimony, in which the simplest model is preferred. Furthermore, models with greater degrees of freedom tolerate a greater potential for rejection (Kline, 2015). Four individual relationships were removed: (1) the relationship between teacher autonomy and collective responsibility (β=-.009; *SE*=.064; p=.892); (2) the relationship between teacher autonomy and reflective dialogue (β=.018; *SE*=.057; p=.758); (3) the relationship between transformational leadership by the principal and teachers' self-efficacy (β=.027; *SE*=.055; p=.621); and (4) the relationship between transformational leadership by the principal and reflective dialogue (β=.036; *SE*=.053; p=.498). After removing these non-significant relationships, all the remaining relationships were significant. The goodness-of-fit indices of the final model provide a good fit to the data (χ^2=6.926, *df*=10, p=.732; χ^2/df *ratio*= .693; *CFI*=1.000; *TLI*=1.039; *RMSEA*=.000, with a *90% confidence interval* of .000-.044; and *SRMR*=.030). Nevertheless, additional information

regarding these fit indices was needed. The *CFI* and *RMSEA* in this path model were fixed at 1 and at 0 respectively. This has to do with their formula that is based on the *Chi-square test statistic*. If the *Chi-square* value is lower than the degrees of freedom, the *CFI* is automatically fixed at 1 and the *RMSEA* at 0 (e.g. Hu and Bentler, 1999). These values appear to refer to overfitting, but the model still has some degrees of freedom (i.e. *df*=10), indicating a non-saturated model that has the possibility to test relationships (Kline, 2015). Because of the reported remarks concerning the *Chi-square test statistic*, the *CFI* and the *RMSEA*, it is recommended to evaluate other fit indices as well (Hu and Bentler, 1999). Regarding this recommendation, the *TLI* and the *SRMR* are also reported. First, the *TLI* for the present model is 1.039, indicating a good fit. According to Bollen and Curran (2006), a *TLI* value larger than .95 and smaller than 1.20 indicates a good fit. Second, the *SRMR* is .030, also indicating a good fit (Hu and Bentler, 1999). The standardised regression coefficients, significance levels of the direct effects, and explained variances of the variables in the model are displayed in the final model in Figure 2.

Figure 2: Final model with standardized regression coefficients (standard errors) (* p<.05; ** p<.01; *** p<.001).



Note. For gender, the unstandardized regression coefficient is used to facilitate interpretation.

Research question 1

The first research question investigated the relationships between interpersonal characteristics of PLCs. The mental PLC characteristic collective responsibility is positively related to the behavioural PLC characteristic reflective dialogue (β=.392; *SE*=.046; p<.001). However, no relationships regarding the behavioural PLC characteristic deprivatized practice were investigated based on the decision to exclude this variable from the path analysis.

Research question 2

The second research question examined the relationship between transformational leadership by the principal and teacher autonomy and interpersonal PLC characteristics. Transformational leadership by the principal is only positively related to collective responsibility (β=.144; *SE*=.065; *p*=.026). Furthermore, the relationship between transformational leadership by the principal and reflective dialogue is fully mediated by collective responsibility (β=.057; *SE*=.028; *p*=.038). Regarding teacher autonomy, there were no significant relationships with the interpersonal PLC characteristics.

Research question 3

The third research question explored the role of teachers' self-efficacy in the relationship between transformational leadership by the principal and teacher autonomy, and interpersonal PLC characteristics. Reflective dialogue is positively and directly affected by teachers' self-efficacy (β=.188; *SE*=.052; *p*<.001). Similarly, there is a positive direct relationship between teachers' self-efficacy and collective responsibility (β=.188; *SE*=.073; *p*=.010). Moreover, the relationship between teacher autonomy and reflective dialogue (β=.114; *SE*=.036; *p*=.002) on the one hand, and teacher autonomy and collective responsibility (β=.108; *SE*=.045; *p*=.016) on the other hand, is fully mediated by teachers' self-efficacy.

Finally, the control variable 'gender' shows that male teachers engage less in reflective dialogue than female teachers (β=-.172; *SE*=.045; *p*<.001). The control variable 'teaching experience' is positively related to teachers' self-efficacy (β=.156; *SE*=.051; *p*=.002) and teacher autonomy (β=.106; *SE*=.046; *p*=.020).

Discussion

PLCs are well-documented in educational research and are pivotal for teachers' professional

development and school improvement (e.g. Bolam et al., 2005; Hargreaves, 2007; Stoll et al., 2006; Verbiest, 2008; Vescio, Ross, and Adams, 2008). Departments should operate as PLCs, and ways of developing and improving PLC characteristics in departments should be explored. The aim of this study was to examine the relationship between different interpersonal characteristics of PLCs on the one hand, and several variables related to PLCs (i.e. transformational leadership by the principal, teacher autonomy, and teachers' self-efficacy) on the other hand. This offers a deeper insight into how interpersonal PLC characteristics are interwoven and can be encouraged.

First, this study revealed a positive direct relationship between collective responsibility and reflective dialogue. To our knowledge, no large-scale quantitative studies have investigated the interplay between these interpersonal PLC characteristics. This result is in line with assumptions in previous qualitative studies, which suggest that teachers who are concerned with the teaching practice of each teacher and the learning outcomes of each student (i.e. collective responsibility) receive a strong incentive to engage in meaningful collaborative behaviours with the entire team (i.e. reflective dialogue) (Bryk, Camburn, and Louis, 1999; Hargreaves, 2007; Vanblaere and Devos, 2016). Collective responsibility is an important mental PLC characteristic, as it ensures that teachers adopt a broader view of their responsibilities within their department (Hargreaves, 2007).

Second, there is a positive direct relationship between transformational leadership by the principal and teachers' collective responsibility. The higher teachers' perceptions of their principal as a transformational leader are, the higher their perceptions of collective responsibility in their department. This result can be explained by the focus that transformational leadership by the principal and collective responsibility have on vision building (Hallinger, 2003). The school vision of the principal can guide the specific vision of

teachers in relation to student learning (i.e. collective responsibility). Furthermore, principals who focus on motivating their teachers and raising their capacities (Leithwood, 1992) ensure higher levels of collaborative work and improvement of instruction (Hargreaves, 2007). However, the small but significant variance explained in collective responsibility indicates that many factors could play a role in influencing interpersonal PLC characteristics (e.g. departmental leadership [Vanblaere and Devos, 2017], and norms and beliefs in the school [Bolam et al., 2005]). Further research on the factors that stimulate collective responsibility in departments is needed. Moreover, the findings reveal no direct significant relationship between transformational leadership by the principal and reflective dialogue. This relationship is fully mediated by teachers' collective responsibility. This contradicts the study conducted by Bryk, Camburn, and Louis (1999), in which principals were found to have a direct effect on the creation of a learning organisation. However, transformational principals can have an indirect role (Vanblaere and Devos, 2016). For instance, the more teachers perceive their principal to have transformational leadership abilities, the more they can contribute to the consensus among teachers regarding the frequency and content of reflective dialogue (Vanblaere and Devos, 2016).

Third, teacher autonomy has no direct significant relationships with collective responsibility and reflective dialogue. One possible explanation for this is that teachers traditionally experience a high degree of autonomy (Clement and Vandenberghe, 2000). Accordingly, teachers do not interact frequently with team members to share knowledge and experiences or ask for feedback. Asking for feedback means exposing oneself to possible criticism, which teachers may want to avoid (Oude Groote Beverborg, Sleegers, and van Veen, 2015). Therefore, the full potential of teacher autonomy must be further explored. This is also in line with the study conducted by Geijsel et al. (2009), who found that certain school context factors directly

influence teachers' professional behaviour, whereas other school context factors only affect teachers' professional behaviour in an indirect way.

This study explored the role of teachers' self-efficacy in the relationship between school context factors and interpersonal PLC characteristics. Teacher autonomy indirectly affects interpersonal PLC characteristics through its relationship with teachers' self-efficacy. First, highly autonomous teachers expressed higher levels of self-efficacy. Second, teachers with higher levels of self-efficacy have a higher collective responsibility and engage more in reflective dialogue, and are therefore more open to collaborate or take mutual responsibility. This is in line with research conducted by Kennedy and Smith (2013). These significant relationships also confirm the mediating role of teachers' self-efficacy in explaining the influence of context factors on teachers' behaviour (e.g. Chan et al., 2008; Xanthopoulou et al., 2007). Furthermore, these findings support the research of Clement and Vandenberghe (2000), who assume that teacher autonomy is not disparate from collaboration or participation in PLCs.

Our results indicate that male teachers engage less in reflective dialogue than female teachers, which supports the findings of Richter et al. (2011). We also found that teaching experience is positively related to teachers' self-efficacy (Chan et al., 2008) and teacher autonomy. Perhaps the more experience teachers have, the more they use the freedom given to them by the school.

Limitations

This study has certain limitations. First, only self-report measures were used. However, in educational research it is not unusual to measure school context factors through self-reports. This provides data on teachers' subjective experiences of the school context. However, the findings of this study should be treated with caution. Future research could integrate triangulated data about the school context by including other actors in the school, such as the

principal. The second limitation concerns the behavioural PLC characteristic deprivatized practice. The results showed that teachers feel collectively responsible in their department and have frequent reflective dialogues with their department colleagues. However, the mean of deprivatized practice was very low. Therefore, only two interpersonal PLC characteristics were included in the path analysis. The results should therefore not be generalised to all PLCs, but rather understood in relation to the specific interpersonal PLC characteristics that were under investigation. More research is needed to confirm the differential relationships with the interpersonal PLC characteristics and explore the role of deprivatized practice within departments where teachers observe each other's teaching practice more frequently. Third, the cross-sectional design of this study makes it difficult to draw conclusions about causality. Longitudinal research is necessary to provide a greater understanding of the direction of the relationships in the path model. The final limitation concerns the context of the present study, which is mathematics, French and General Studies departments as departmental PLCs in Flemish (Belgian) secondary education. The specific national policy context of the present study might have influenced the results. For instance, the Department of Education of the Flemish government has developed a teacher career profile for teachers (Departement Onderwijs en Vorming, 2007). This teacher career profile describes the knowledge, skills, and attitudes that a teacher needs in order to be able to function effectively. Ten broad job specifications are included. One of these job specifications is 'the teacher as a member of a school staff team', which demonstrates that teachers are no longer only expected to be teachers in their own classroom. Hence, the policy makers acknowledge the importance of belonging to a team. More specifically PLC are mentioned for that matter. Still, only in a brief section at the end of the teacher career profile. However, one of the largest stakeholders in the educational field in Flanders already acknowledges and stimulates departments to function as learning

communities. Although this study was conducted in the Flemish (Belgian) context, the results can still be transferred to other similar contexts to give shape to a kind of job specifications of teachers. As such, it remain useful to elaborate our work in other countries with a different policy context. In addition, the present study involved only mathematics, French and General Studies departments and teachers. It would be interesting to conduct a similar study with other subject-teachers in other subject-departments, as subject matter differences with consequences for teachers' teaching practice and collaboration are possible (van Veen et al., 2001).

Implications

The results of this study have several practical implications. First, teachers should be encouraged to engage in in-depth conversations about teaching and learning with colleagues, and share knowledge, experiences and practices with each other (i.e. reflective dialogue and collective responsibility) (Vanblaere, 2016). Furthermore, this study confirmed the importance of teachers' perception of transformational leadership by the principal for their collective responsibility (Vanblaere and Devos, 2016). In this respect, principals have the important role of creating conditions that support collective responsibility among teachers. In this way, reflective dialogue among teachers is stimulated. Moreover, both collaboration (i.e. through participation in PLCs) and autonomy are important for teachers. Principals should stimulate both of these work practices (Clement and Vandenberghe, 2000). Furthermore, since teachers' self-efficacy is a significant individual teacher characteristic, schools should note its importance, for instance, by supporting teachers or providing them with positive feedback to help increase their sense of efficacy (Runhaar, Sanders, and Yang, 2010). With a good combination of transformational leadership by the principal, the necessary school conditions (i.e. teacher autonomy), and high self-efficacy, a departmental culture of collaboration can be created. This could lead to PLC characteristics in departments that have the potential to improve

teachers' professional development, the school itself, and in the longer term, the quality of education (Stoll et al., 2006).

1. General Studies [Project Algemene Vakken=PAV] is a transdisciplinary subject taught in vocational secondary education that uses an integrated approach to learning contents, such as mother tongue/linguistics, mathematics, communication and organisational skills, and social studies.

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