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The relationship between job demands, job resources and teachers' professional learning: is it explained by self-determination theory?

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ABSTRACT

Although teachers' commitment to continuous professional learning is crucial for high quality education, research shows that this learning cannot be taken for granted. To better understand how teachers' learning at work can be supported, this study investigates how effects of job demands (i.e. work pressure and emotional pressure) and job resources (i.e. task autonomy, transformational leadership, and collegial support) on teachers' learning commitment (i.e. learning frequency and engagement) can be explained by basic psychological need satisfaction and autonomous motivation, as posited by self-determination theory. At two occasions, approximately one year apart, data was collected in a sample of 678 (T1) and 536 (T2) Dutch secondary school teachers. Structural equation models showed the consecutive positive longitudinal relationships between teachers' experience of job resources, basic psychological need satisfaction, autonomous motivation, and commitment to professional learning. Job demands were not related to basic need satisfaction over and above the effects of job resources. Implications for how self-determination theory and the job demands resources model can mutually inform each other are discussed. In addition, implications for stimulating teachers' professional learning in practice are provided.

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KEYWORDS

Job demands; job resources; motivation; self-determination theory; teacher professional learning

Research literature shows consensus on the need for teachers to continuously learn and develop. Teacher learning is required in many countries because of ongoing educational changes and because it is assumed to improve the quality of education for students (Admiraal et al. 2016; Lieberman and Pointer Mace 2008; Runhaar, Sanders, and Yang

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2010; Tuytens and Devos 2011; Vermunt and Endedijk 2011). However, teachers' involvement in professional learning cannot be taken for granted. In 2007–2008, an average of 11% of teachers, in representative samples across 23 relatively prosperous countries reported to not have performed any learning activities. These activities included learning that teachers could accomplish at their own initiative, based on their own learning goals and strategies (OECD 2009). Moreover, studies in Germany and Belgium showed that the recurrence with which teachers reported to perform learning activities decreased as they got older (Richter et al. 2011; van Daal, Donche, and De Maeyer 2014). In sum, although teachers learning is valued in both practice and research, the extent to which teachers perform learning activities can be improved. This emphasises the importance of better understanding the conditions that promote teachers' commitment to professional learning, which is the main objective of this study.

Currently, many countries seem to have stronger accountability pressures for professional learning and development of their teachers than the Netherlands, where this study was conducted (Louws et al. 2017). Dutch teachers are asked to use ten percent of their total time for professional learning activities. However, participation in learning activities is rarely monitored or evaluated by schools. Moreover, unlike other countries like Australia (Baker et al. 2018) and several states of the USA (Jaquith et al. 2010) currently there is no national qualification system for continuing professional development that requires teachers' investment in learning to maintain their accreditation. As such, Dutch teachers' professional learning is mainly a matter of their professional autonomy and personal responsibility. Nevertheless, Dutch teachers vary considerably in the extent to which they report to perform learning activities (Bakkenes, Vermunt, and Wubbels 2010; Kwakman 2003). In part, this could be due to the way the teaching job is organised in the Netherlands. Full-time teachers teach 25 classes every week, which is more than most of their European colleagues (OECD 2017). On top of that, teachers have to perform other tasks like preparing lessons administrative tasks, designing materials and assessments, and grading students' work. At the same time, these primary tasks seem to require more hours than formally allocated to teachers (AoB 2017). This means that teachers always have to weigh spending time on professional learning activities against spending time on tasks related to the primary teaching-learning process (Admiraal et al. 2016). As such, understanding conditions that promote teachers' participation in professional learning is also important for the Dutch context specifically.

Teachers' performing of learning activities has previously been explained through conditions in teachers' work environment as well as teachers' personal and psychological attributes (Admiraal et al. 2016; Kwakman 2003; Lohman 2006; Smylie 1988; Thoonen et al. 2011). According to the job demands-resources (JDR) model, conditions in the work environment related to teachers' performing of professional learning activities can be organised into two categories – job demands and job resources (Bakker and Demerouti 2017). The JDR model states that learning of teachers will occur in work environments that hold more or higher job resources relative to job demands. However, the JDR model overlooks psychological mechanisms that explain the positive effects of job resources on teachers' learning (Schaufeli and Taris 2014).

Insight into these psychological mechanisms is important because it provides an understanding of why teachers who work under the same conditions may still vary in their professional learning. This knowledge can aid targeting interventions that stimulate

professional learning among teachers. Furthermore, insight into the psychological mechanisms that explain the relation between work environment and teachers' professional learning contributes to our reasoning about unexplored factors that influence teacher learning. Although previous research suggests that psychological attributes mediate effects of the work environment on teachers' learning (Kwakman 2003; Smylie 1988; Thoonen et al. 2011), systematic research remains scarce.

One psychological attribute that has recently received attention in relation to teachers' professional learning is motivation for learning from the perspective of self-determination theory (SDT; Gorozidis and Papaioannou 2014; Jansen in de Wal et al. 2014). SDT assumes that commitment to learning follows from autonomous motivation (i.e. acting out of reasons associated with volition and self-endorsement, such as interest and personal values) (Deci and Ryan 2000; Vansteenkiste et al. 2009). A second assumption of SDT is that individuals will only act out of autonomous motivation when their basic needs for autonomy, competence, and relatedness are satisfied. Importantly, the satisfaction of basic psychological needs is determined by individuals' perceptions of their environments (Deci and Ryan 2000). As such, both the JDR model and SDT assume that teachers will show personal and professional growth and development as long as their environments provide the right conditions.

The present study proposes that SDT can serve as an explanatory framework for the relationship of job demands and job resources with teachers' commitment to professional learning that is proposed by the JDR model. The JDR model currently does not include such an explanatory framework. In the following sections teachers' professional learning is defined, SDT and the JDR model are discussed in more detail, and hypotheses about the connection between both theories are presented.

Teachers' commitment to professional learning

We define teachers' professional learning as the process by which teachers acquire knowledge, skills, and values that will improve the service they provide to students (Hoyle and John 1995). In this study, we approach this process by focusing on the intentional performing of learning activities by teachers at the workplace. The reasons for choosing this conceptualisation are that a) motivated behaviour often encompasses direction, persistence, and intention (Ryan and Deci 2000), and b) in many countries, including the Netherlands, most opportunities for teachers' learning after formal certification are situated at the workplace (Hoekstra and Korthagen 2011; Lohman and Woolf 2001; Richter et al. 2011).

Teachers' intentional learning at work can occur through performing formal and informal learning activities (Richter et al. 2011). Formal learning activities include workshops, in-house courses, and other activities organised by external agents. Informal learning activities, on the other hand, are organised by teachers themselves, based on their own learning goals and strategies. Informal learning activities performed by teachers include reading, experimenting, reflecting and collaborating (e.g. Evers, Kreijns, and van der Heijden 2015). We consider teachers to be committed to intentional learning at the workplace, either formal or informal, when they perform learning activities with high frequency and high engagement. By high frequency, we mean that teachers perform learning activities often. We consider high engagement in learning to be characterised by learning with vigour, dedication, and absorption. As such, high engagement in learning involves, for

example, high levels of energy and mental resilience (vigour); the willingness to invest effort and persistence in the face of difficulties (dedication), and immersion (absorption) (cf. Schaufeli et al. 2002).

Self-determination theory

As noted above, SDT states that high frequency of, and engagement in learning follows from autonomous motivation (see Figure 1, Model C; Deci and Ryan 2000; Vansteenkiste et al. 2009), which is characterised by high amounts of volition and choice. Autonomous motivation can be subdivided into intrinsic motivation and identified regulation. Intrinsic motivation concerns doing something out of reasons that originate completely within the self, such as enjoyment, curiosity, or the wish to perform tasks that correspond with current capacities (i.e. are optimally challenging). Performing activities out of identified regulation, on the other hand, is fuelled by the value and importance that individuals ascribe to the external outcomes of those activities. Autonomous motivation results in high frequency and quality of behaviour because intrinsic motivation ensures engagement in short-term, fun, and interesting activities, while identified regulation sustains engagement in activities that are not necessarily enjoyable (Koestner and Losier 2002). Autonomous motivation is contrasted with amotivation and controlled motivation. Amotivation refers to a lack of intention to behave, whereas controlled motivation denotes acting out of external or internal pressures.

Teachers' autonomous motivation for learning is positively influenced by the extent to which teachers perceive their environment to satisfy three basic psychological needs (see Figure 1, Model B). These needs comprise the need for autonomy (i.e. the perception that one is the origin of one's own behaviour), the need for competence (i.e. feeling effective in ongoing interactions with the social environment and experiencing opportunities to exercise and express capacities) and the need for relatedness (i.e. feeling connected to others,

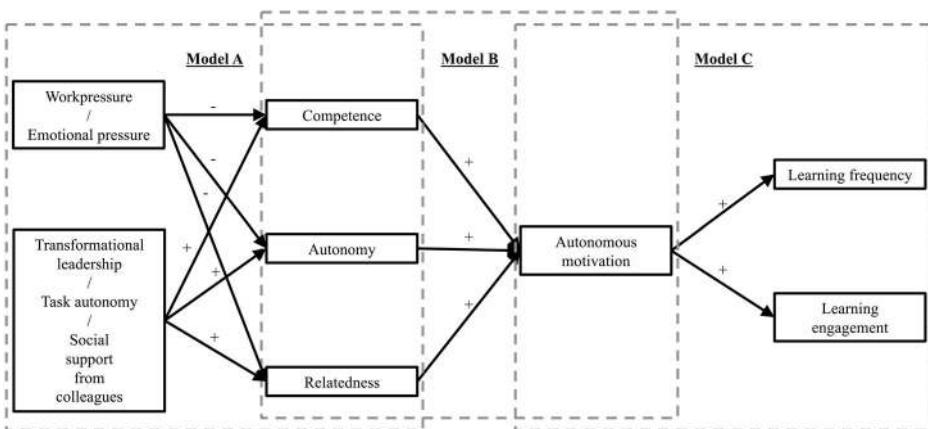


Figure 1. Hypothesised relationships between job demands and job resources, basic psychological need satisfaction, motivation, and frequency and engagement in professional learning. All job demands and job resources on the left side of the model will be included in analyses as separate variables.

caring for and being cared for by those others, and having a sense of belonging both with other individuals and with one's community). When people are deprived of basic need satisfaction, or when basic needs are actively frustrated, controlled motivation or amotivation are the result (Deci and Ryan 2000).

Autonomy satisfaction is the most central basic need with respect to determining individuals' motivation. When the need for autonomy is satisfied, teachers can perform the learning activities that they would choose for themselves, based on their own interests and learning wishes or needs (i.e. autonomous motivations). The perception of being competent is likely especially relevant for intrinsic motivation for professional learning. That is, in order to experience joy, remain curious, or feel positively challenged, teachers need to feel that they are able to effectively bring learning tasks to an end. If not, they will presumably not gain satisfaction from the learning itself and lose intrinsic motivation. Finally, feeling related to colleagues likely contributes to autonomous motivation for learning because feeling connected and respected can allow teachers to choose for learning activities themselves without having to be afraid of colleagues' judgments.

Although investigations of teachers' motivation for professional learning are still scarce (Vermunt and Endedijk 2011), the existing research supports the assumptions of SDT discussed above (Gorozidis and Papaioannou 2014; Jansen in de Wal et al. 2014). Therefore, we hypothesise that:

H1: Autonomous motivation relates positively to teachers' performing of, and engagement in learning activities (Figure 1, Model C).

H2: Satisfaction of the needs for autonomy, competence, and relatedness regarding professional learning relates positively to autonomous motivation for that learning (Figure 1, Model B).

The job demands-resources model

The JDR model was originally developed to explain burnout and work engagement of employees (Bakker and Demerouti 2017). Job demands are defined as aspects of the job that require sustained physical and/or psychological effort or skills, and are therefore associated with certain physiological and/or psychological costs, such as emotional exhaustion and job-related anxiety. Job resources are aspects of the job that are functional in achieving work goals, reducing job demands and their associated costs, or stimulating personal growth, learning, and development. Typical examples of job demands and resources are work pressure and task autonomy, respectively (Schaufeli and Taris 2014). Generally, the JDR model states that burnout follows from low job resources and high job demands, while work engagement follows from high job resources (Bakker and Demerouti 2007; Schaufeli and Taris 2014).

Previous research among teachers and educational professionals convincingly shows that the effects of job demands and resources on burnout and work engagement can be explained through SDT constructs. First of all, multiple studies show that the effects of job demands and resources on (indicators of) burnout and work engagement are in line with the JDR model (Bakker and Bal 2010; Dicke et al. 2018; Hakanen, Bakker, and Schaufeli 2006; Yin, Huang, and Wang 2016). Fernet and colleagues add to these results that job resources contribute to occupational commitment through their positive (cross-lagged)

effect on the autonomous work motivation of teachers and school principals (Fernet et al. 2016; Fernet, Austin, and Vallerand 2012). Moreover, they show that the positive effect of job demands (i.e. work overload) on emotional exhaustion can be explained through their differential effect on autonomous motivation and controlled motivation (Fernet et al. 2012, 2016). The role of basic psychological need satisfaction in the relationship of job demands and resources with burnout and work engagement has not been studied among teachers. However, in general samples of employees, job demands and resources were found to differentially relate to basic psychological need satisfaction which, in turn, was related to indicators of burnout and work engagement (Fernet et al. 2013; Van den Broeck et al. 2008).

Teachers' experience of job demands and resources has also been found to be related to their self-reported professional learning behaviour (De Neve, Devos, and Tuytens 2015; Evers et al. 2016; Kwakman 2003; Taris et al. 2003). Moreover, a study among Dutch employees showed that both job demands and job resources are positively related to learning related behaviour and motivation to learn over time (De Lange et al. 2010). However, whether these effects can also be attributed to basic psychological need satisfaction and subsequent autonomous motivation is unclear from current research.

Job resources, basic need satisfaction and teachers' professional learning. According to their definition, job resources stimulate personal growth, learning and development among employees (Bakker and Demerouti 2017). Nonetheless, little is known about the psychological mechanisms through which job resources are supposed to stimulate learning on the job (Schaufeli and Taris 2014). Bakker and Demerouti (2007) propose that a motivational process underlies this relationship. However, to our knowledge, this argument has not been elaborated on anywhere, nor has it been tested empirically. As mentioned above, earlier research on work motivation in general did show a positive relationship between job resources, basic psychological need satisfaction, and autonomous work motivation (Fernet et al. 2013, 2016; Fernet, Austin, and Vallerand 2012; Van den Broeck et al. 2008). Therefore, we propose that SDT also provides the necessary theoretical framework to explain the relation between job resources and professional learning (see Figure 1, Model A).

Based on earlier research that shows positive effects of job resources on teachers' performing of learning activities, three job resources were included in this study. These resources concern task autonomy, social support from colleagues, and transformational leadership by direct supervisors. First, task autonomy comprises the extent to which teachers themselves can decide on when and how to execute their work. Two studies investigated the effect of task autonomy on teachers' professional learning and found a positive relationship (De Neve, Devos, and Tuytens 2015; Kwakman 1998). Because task autonomy provides teachers with relative freedom for arranging their work activities, including professional learning, we expect a positive relationship between task autonomy and autonomy satisfaction. In addition, being allowed to determine their own pace and methods of work, including professional learning, can enhance teachers' feelings of being trusted and taken seriously by supervisors. As such, we expect that task autonomy may also positively influence teachers' perceptions of competence and relatedness for professional learning.

Second, social support from colleagues encompasses helpful social interactions available from colleagues on the job (Kwakman 2003). This support has also been found to relate positively to the reported performing of professional learning of teachers (Evers

et al. 2016; Kwakman 2003) and other employees (Raemdonck, Gijbels, and van Groen 2014). We hypothesise that these positive effects can be primarily explained via relatedness satisfaction, since social support concerns colleagues' willingness to listen to teachers' problems and concern for teachers' functioning. However, helpful social interactions from colleagues may also contribute to feelings of competence, for example when colleagues give feedback and support for (learning) tasks. This could also provide teachers with more experienced psychological freedom to choose for learning activities that they would like to perform, and hence increase feelings of autonomy.

Finally, transformational leadership is included as a job resource. The positive relationship between transformational leadership and teachers' professional learning has been established in several studies (Runhaar, Sanders, and Yang 2010; Thoonen et al. 2011; Tuytens and Devos 2011). It refers to leaders' values and practices that stimulate employees' capacity development and job-dedication for the purpose of organisational change. This development and dedication goes beyond what would be expected from employees based on their job descriptions (Bass and Avolio 1994). Among school leaders, three core transformational leadership practices have been found. These include 1) vision building: identifying and communicating a vision for the school, 2) individual support: showing concern and respect for teachers' feelings and needs, and 3) intellectual stimulation: challenging teachers to professionalise themselves (Thoonen et al. 2011). In performing these practices, transformational leaders seek to fulfil their followers' 'higher needs' (Burns 1978, 4), which can be described through SDT's needs for autonomy, competence, and relatedness (Kovjanic et al. 2012). Therefore, we expect that transformational leadership positively influences basic psychological need satisfaction and thereby autonomous motivation for and commitment to professional learning. In sum, we hypothesise that:

H3: Job resources relate positively to teachers' basic psychological need satisfaction for professional learning (Figure 1, Model A).

Job demands, basic need satisfaction and teachers' professional learning. Unlike job resources, job demands are not proposed by the JDR model to show a direct relationship with professional learning. However, several studies did investigate associations between job demands and professional learning of teachers and other employees. In these studies, work pressure and emotional pressure have been consistently included because they are relevant for teachers' everyday work practice (Evers et al. 2011, 2016; Kwakman 1998, 2003). Work pressure refers to quantitatively demanding aspects of the job such as workload and the pace of work. Emotional pressure is defined as the extent to which teachers perceive their jobs to require emotional investment.

Based on a precursor of the JDR model, the job demands control model (Karasek and Theorell 1990), some studies expected and found positive relationships between these job demands and reported performing of professional learning activities (Evers et al. 2016; Kwakman 2003; Raemdonck, Gijbels, and van Groen 2014). On the other hand, studies also reported negative relationships between job demands and self-reported learning behaviour (Taris et al. 2003) or found mixed results (Morrison et al. 2005).

An explanation for these mixed findings, also suggested by Evers et al. (2016) and Morrison et al. (2005), is that only moderate job demands create a concern for learning because learning can help to alleviate the negative consequences of these demands. Translated in terms of SDT, this would mean that moderate job demands can cause teachers to feel

controlled motivations (i.e. feel pressured) to improve their circumstances through learning. However, when demands become too pressuring, they lead to exhaustion and the concern for learning disappears. In terms of SDT this would mean that job demands that are too high may cause amotivation for professional learning. As such, if a relationship between job demands and basic psychological need satisfaction exists, it can be expected to be negative. First of all, because both controlled motivation and amotivation follow from thwarting basic psychological needs (Deci and Ryan 2000). Second, by definition job demands are associated with psychological costs. Therefore, we hypothesise that:

H4: Job demands relate negatively to teachers' basic psychological need satisfaction for professional learning (Figure 1, Model A).

In sum, this study investigates whether the effects of job demands and resources on teachers' commitment to professional learning can be explained through basic psychological need satisfaction and, consequently, autonomous motivation. Based on earlier research and theoretical considerations, it is expected that job resources relate positively to basic psychological need satisfaction, whereas job demands are anticipated to show a negative relationship. Figure 1 summarises all hypotheses evaluated in this study.

Method

Sample and procedure

Two waves of questionnaire data were obtained from teachers to test our hypotheses. The first questionnaire (T1) was administered in September 2013, and the second (T2) in October 2014. The participating teachers were acquired through one of our previous studies (Jansen in de Wal et al. 2014). From the 2360 secondary school teachers who voluntarily participated in that study, 1517 indicated to be available for further research. For both data waves, these teachers were sent an invitation to participate in the current study via e-mail. This e-mail contained a link to the questionnaire and information on the benefits of participating, which included the chance to win one of two prizes, worth approximately €250. Respondents in the present study were 678 Dutch secondary school teachers at T1 and, due to attrition, 536 at T2.

At T1, these teachers were employed at 155 of the 1396 secondary school locations in the Netherlands. Sample statistics and population parameters regarding age, sex, and teaching qualification are presented and tested for equivalence in Table 1. The table shows that the sample was significantly older and contained fewer females than the population. In terms of teaching qualifications, the sample included an overrepresentation of

Table 1. Differences between achieved sample statistics and population parameters.

	Population ($N \approx 75.000$)	Sample	t (df = 638)	p -value
Mean age	44.60	50.70	16.04	<.001
Females	51.33%	43.50%	-3.99	<.001
1st level qualification	40.80%	49.20%	4.21	<.001
2nd level qualification	45.20%	48.50%	1.68	.095
No qualification	8.80%	2.30%	-10.77	<.001

Note: Population parameters were retrieved from <http://www.ib-groep.nl> and <http://www.stamos.nl>.

teachers with a first level (i.e. highest) teaching qualification and an underrepresentation of teachers without a qualification. Teachers without a qualification mostly still train for certification. All types of secondary education in the tracked Dutch school system were represented. On average the teachers had 24.72 years of teaching experience ($SD = 10.36$) and taught 17.39 lessons per week ($SD = 6.19$).

Measures

All measures employed in the questionnaire for this study concern (adaptations of) instruments that have been validated in Dutch samples. The number of items and sample items for all instruments are displayed in Table 2. The questionnaire started with the TPD@Work scale (Evers, Kreijns, and van der Heijden 2015). This self-report instrument measures the frequency with which teachers perform learning activities (i.e. reading, work related training, experimenting, reflecting, and collaborating). Items were rated on a Likert-type answering scale ranging from 1 ‘almost never’ to 4 ‘often’.

Teachers’ engagement in learning activities was measured only at T2 with an adaptation of the Utrecht Work Engagement Scale (UWES; Schaufeli et al. 2002). The adaptation of this questionnaire for our purpose comprised rewriting the items so that they referred to vigour, dedication, and absorption for professional learning instead of work.

Table 2. Questionnaire details of all measures employed in this study.

Questionnaire	Sub-scales	items	α	Sample item
Performing learning activities	Reading	3	.74	Studying subject matter literature
	Work related training	2	.73	Participating in a course that focuses on subject matter pedagogy
	Experimenting	5	.83	Testing alternative materials in class
	Reflecting	4	.71	Adapting my teaching methods in response to pupils’ reactions
	Collaborating: Lesson	3	.67	Preparing lessons with colleagues
	Collaborating: School	4	.76	Thinking about the design and method of pupil guidance with colleagues
Engagement in learning	Vigour	6	.92	When I perform professional learning activities I feel as if I’m bursting with energy
	Dedication	5	.92	I find my professional learning meaningful and purposeful
Autonomous Motivation	Absorption	6	.91	I get carried away with my professional learning
	Intrinsic motivation	4	.92	... because I enjoy doing it
Basic Need Satisfaction	Identified regulation	4	.87	... because it is personally important to me
	Autonomy	4	.83	... I feel that my decisions reflect what I really want
	Competence	4	.80	... I feel competent to achieve my goals
Work Pressure	Relatedness	4	.88	I feel close and connected to the people who are involved in my professional development
	Emotional pressure	7	.88	Do you work under time pressure?
	Task autonomy	4	.72	Is your work emotionally challenging?
	Transformational leadership	5	.81	Can you decide on your own pace of work?
	Vision building	5	.92	... clearly defines current problems from the perspective of a vision of the future of the school
	Individual support	4	.90	... takes the beliefs of individual teachers seriously
	Intellectual stimulation	6	.92	... encourages teachers to try new things in line with their own interests
Social support colleagues		4	.88	My colleagues show concern for the way I function at work

All items were rated on a Likert-type answering scale ranging from 0 'never' to 6 'always'.

Autonomous motivation for professional learning was measured with an adaptation of the Dutch Academic Self-Regulation Scale (Vansteenkiste et al. 2009). The adaptation comprised replacing the original sentence 'Why are you studying in general? I'm studying ...' preceding each item with 'I perform professional learning activities ...'. Only the intrinsic motivation and identified regulation subscales of this questionnaire were employed. Items were rated on a Likert-type answering scale ranging from 1 'completely not applicable to me' to 5 'completely applicable to me'.

The extent to which teachers' basic psychological needs for professional learning were satisfied by their environments was measured with an adapted version of the basic psychological need satisfaction scale, developed by Chen et al. (2015). The items measuring autonomy and competence satisfaction were preceded by the stem: 'With respect to my professional learning ...'. The items measuring relatedness were adapted so that they would be applicable to the purpose of this study. For example, the original item 'I feel close and connected with other people who are important to me' was changed to 'I feel close and connected to the people who are involved in my professional development'. All items were rated on a Likert-type answering scale ranging from 1 'completely not applicable to me' to 5 'completely applicable to me'.

Next, job demands and job resources were measured. Work pressure, emotional pressure, and task autonomy were measured with three subscales of the Dutch Questionnaire Social Psychological Work Demands (Van Veldhoven and Meijman 1994). Social Support from Colleagues was measured by four items validated by De Jonge et al. (2008). All items of these scales were answered on Likert-type answering scales ranging from 1 'almost never' to 4 'often'. Transformational leadership was measured through a scale developed by Geijsel, Sleegers, Stoel, and Krüger (2009). All items of this scale were preceded by the stem: 'My direct supervisor ...' and answered on Likert-type answering scales ranging from 1 'completely disagree' to 6 'completely agree'.

Quality of measures. Confirmatory factor analyses (CFAs) were performed separately on the measures of job demands and job resources, basic need satisfaction, autonomous motivation, and commitment to learning. These analyses included the T1 and T2 measures of all variables except learning quality, which was only measured at T2. All items in these models loaded on their own factors, and factors were allowed to correlate within and between data waves. In addition, all error terms of equivalent items were allowed to correlate over time to control for common method variance (Cole and Maxwell 2003). Learning frequency, learning engagement, and transformational leadership were included as second order factors in their respective models. Their respective first order factors are displayed in Table 2. In line with Vansteenkiste et al. (2009), autonomous motivation was included as a first order factor, loading on items measuring identified regulation and intrinsic motivation. Table 3 shows that all factor models fit well to the data, according to the criteria that require RMSEA to be smaller than .06, CFI and TLI to approach .95, and SRMR to be smaller than .08 (Hu and Bentler 1999).

After establishing that the same constructs were manifest in our data at both time points, metric longitudinal measurement invariance was imposed on the factor models by constraining the factor loadings of equivalent items to be equal over time. This procedure tests whether constructs are also measured in a similar way over time (Coertjens

Table 3. Factor analyses and metric longitudinal measurement invariance of all questionnaires included in this study.

	Baseline factor analyses					Metric longitudinal measurement invariance	
	χ^2 (df)	CFI	TLI	RMSEA	SRMR	$\Delta \chi^2$ (df)	Δ CFI
JDR	4221.46(2259)***	.92	.92	.03	.06	32.74(38) ^{n.s.}	<.01
BNS	537.85(225)***	.95	.94	.04	.10	30.30(12)**	<.01
Autonomous Motivation	342.49(95)***	.97	.96	.06	.07	6.27(7) ^{n.s.}	<.01
Learning frequency	1529.06(779)***	.92	.91	.03	.06	23.47(27) ^{n.s.}	<.01
Learning engagement	664.12(101)***	.92	.91	.10	.04		

Note: JDR = Job Demands and Job Resources; BNS = Basic need satisfaction; n.s. = not significant.

*** $p < .001$; ** $p < .01$.

et al. 2012). Metric longitudinal measurement invariance can be evaluated by comparing the fit of the unconstrained factor analysis and the fit of the model assuming equal factor loadings over time through a chi-square difference test ($\Delta\chi^2$) and inspecting the decrease in CFI (Δ CFI). For metric longitudinal measurement invariance to hold $\Delta\chi^2$ should not be significant and Δ CFI should be smaller than .01 (Cheung and Rensvold 2002). For large samples Δ CFI is a more credible measure (Coertjens et al. 2012). Applying these guidelines, Table 3 shows that longitudinal measurement invariance can be assumed for all measures.

Analyses

To evaluate this study's hypotheses, a series of latent structural equation models were tested in Mplus 6.1 (Muthén and Muthén 2010). We chose to include all constructs as latent variables in our analyses to directly include the measurement error (i.e. unreliability) of scores in the explained variance of all variables. This reduces bias in the estimation of effect sizes (Kline 2011, 104). Missing data was handled by the software's full information maximum likelihood (FIML) function. FIML estimation of missing data is appropriate when data is missing at random, which was the case in our dataset (Schafer and Graham 2002).

Based on Cole and Maxwell's (2003) advice for testing mediational models with longitudinal data measured at two points in time, the data were employed in such a manner that every consecutive set of relationships from our theoretical model was tested with the independent variables measured at T1 and the dependent variables measured at T2. These models correspond to Model A, B, and C in Figure 1, respectively. Employing this strategy satisfies the condition that independent variables must be measured before dependent variables to reasonably infer cause-effect relations in structural equation models (Kline 2011, 98).

Results

To gain an initial understanding of relationships between variables in our theoretical model, latent zero-order correlations between variables measured at T1 and T2 are displayed in Table 4. Most of these correlations are in line with our hypotheses. However, emotional pressure at T1 is not related to the satisfaction of any of the basic psychological

Table 4. Latent zero-order correlations between all variables at T1 and T2.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.
1. Work pressure (T1)																				
2. Emotional pressure (T1)	.42***																			
3. Transformational leadership (T1)	-.22***	-.12*																		
4. Task autonomy (T1)	-.52***	-.19***	.28***																	
5. Social support colleagues (T1)	-.08	.01	.20***	.23***																
6. Autonomy (T1)	-.23***	-.04	.26***	.36***	.10*															
7. Competence (T1)	-.13**	-.14**	.18***	.26***	.19***	.51***														
8. Relatedness (T1)	-.14**	-.03	.49***	.33***	.27***	.54***	.32***													
9. Autonomous motivation (T1)	-.04	.02	.13**	.20***	.20***	.72***	.36***	.36***												
10. Learning frequency (T1)	.09	.27***	.16**	.17**	.17***	.52***	.32***	.30***	.59***											
11. Work pressure (T2)	.80***	.36***	-.22***	-.39***	-.09	-.25***	-.14*	-.15*	-.02	.04										
12. Emotional pressure (T2)	.45***	.68***	-.12	-.32***	.07	.08	-.04	-.03	.08	.24***	.47***									
13. Transformational leadership (T2)	-.17**	-.08	.69***	.16*	.13*	.19**	.11	.43***	.07	.08	-.18***	-.03								
14. Task autonomy (T2)	-.46***	-.19**	.32***	.70***	.12	.26***	.22***	.24***	.05	.03	-.45***	-.29***	.34***							
15. Social support colleagues (T2)	-.15*	-.11	.24***	.21**	.53***	.07	.15*	.19**	.12*	.12	-.07	.01	.27***	.16**						
16. Autonomy (T2)	-.24***	.06	.22***	.43***	.07	.75***	.30***	.42***	.57***	.51***	-.24***	-.11	.34***	.33***	.14*					
17. Competence (T2)	-.20**	-.12	.16*	.35***	.14*	.52***	.57***	.29***	.35***	.34***	-.26***	-.15**	.20***	.29***	.15**	.53***				
18. Relatedness (T2)	-.18***	.00	.40***	.26***	.20*	.44***	.20**	.56***	.34***	.32***	-.18***	-.06	.50***	.21***	.32***	.54***	.33***			
19. Autonomous motivation (T2)	-.05	.09	.12*	.27***	.14*	.66***	.22***	.43***	.72***	.52***	-.09	.05	.23***	.18**	.19***	.80***	.36***	.44***		
20. Learning frequency (T2)	.11	.28***	.05	.13*	.14*	.38***	.24***	.23***	.51***	.99***	.08	.29***	.15**	.03	.24***	.47***	.36***	.34***	.49***	
21. Learning engagement (T2)	-.08	.09	.13*	.29***	.13*	.60***	.27***	.41***	.63***	.61***	-.15**	-.01	.22***	.20***	.16**	.74***	.40***	.44***	.85***	.60***

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

Table 5. Model fit of consecutive structural models.

	χ^2 (df)	χ^2 /df	CFI	TLI	RMSEA	SRMR
Model A	2099.64(1003)***	2.09	.93	.93	.04	.05
Model B	428.66(164)***	2.61	.96	.95	.04	.08
Model C	2127.10(933)***	2.28	.91	.91	.04	.07

*** $p < .001$.

needs at T2. In addition, it is noteworthy that work pressure is not related to our measures of professional learning. For a more stringent test of our theoretical model, model A, B, and C from Figure 1 will be evaluated next. Table 5 displays fit indices for all latent structural models tested in this study. All models showed good fit to the data.

Figure 2 represents the observed standardised relationships between job demands, job resources and basic need satisfaction. As expected, task autonomy is positively related to both competence satisfaction and autonomy satisfaction (hypothesis 3). In addition, transformational leadership is positively related to autonomy satisfaction and relatedness satisfaction. All independent variables explain 21%, 16%, and 19% of the variance in teachers' satisfaction of the need for competence, autonomy, and relatedness, respectively.

In contrast to hypothesis 3 and 4, work pressure, emotional pressure, and social support from colleagues were not related to the satisfaction of any of the basic psychological needs in the model. However, the respective negative and positive relationships of work pressure and transformational leadership at T1 with basic need satisfaction at T2 were present when modelled as zero-order correlations (see Table 4). Moreover, task autonomy showed a strong negative correlation with work pressure (see Figure 2). Therefore, we also investigated a model from which task autonomy was omitted. In this model work pressure showed a negative relationship with autonomy satisfaction ($\beta = -.26$, $p < .001$) and relatedness satisfaction ($\beta = -.13$, $p = .04$). However, the variance explained in the

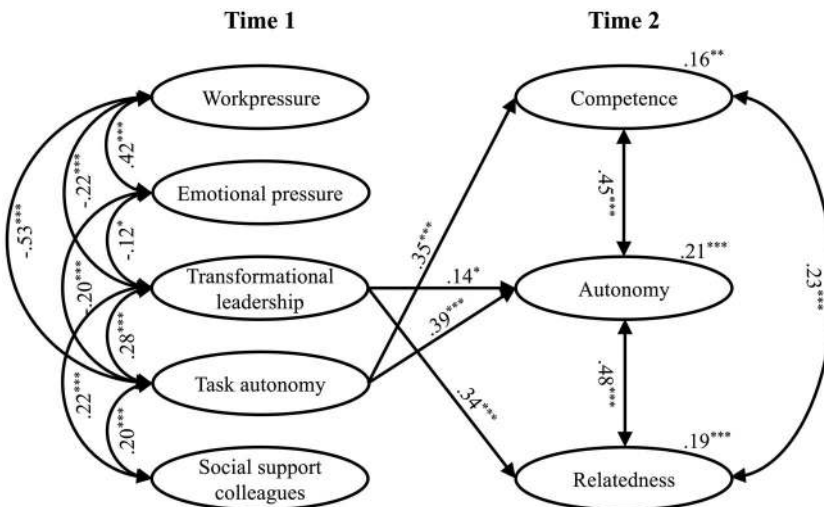


Figure 2. Standardised relationships between job challenges, job resources, and basic psychological need satisfaction.

Note: Non-significant relationships were omitted for clarity. * $p < .05$; ** $p < .01$; *** $p < .001$.

satisfaction of these basic needs decreased by 6% and 2%, respectively, as a consequence. Then, because of the relatively strong correlation between transformational leadership and social support from colleagues (see Figure 2), we also tested a model without transformational leadership as a predictor. In this model, social support from colleagues showed a significant positive relationship with relatedness satisfaction ($\beta = .16, p < .01$). However, the variance explained in relatedness satisfaction decreased by 12%. The results of these analyses show that work pressure and social support from colleagues are related to autonomy and relatedness satisfaction, but not over and above tasks autonomy and transformational leadership, respectively.

The relationships depicted in Figure 3 show that, in line with hypothesis 2, autonomy satisfaction is strongly and positively related to autonomous motivation. The hypothesised relationship between relatedness satisfaction and autonomous motivation was not supported. The direct relationship between competence satisfaction and autonomous motivation reached significance, however, this relation was negative where it was hypothesised to be positive. This model explains 46% of the variance in autonomous motivation.

We performed additional analyses to explain the notable difference in relationship size and direction between the zero-order correlations of competence and relatedness satisfaction at T1 with autonomous motivation at T2 in Table 4, and their respective standardised regression weights in Figure 3. First, we assessed how much variance in autonomous motivation autonomy, competence, and relatedness satisfaction explain individually. Autonomy satisfaction explained 44%, competence satisfaction 5%, and relatedness satisfaction 18%. Then we tested a model in which autonomy and competence predict autonomous motivation together. In this model, the correlation between autonomy and competence is high ($r = .63, p < .001$). Autonomy satisfaction shows a positive relationship with autonomous motivation ($\beta = .81, p < .001$) and competence satisfaction changes into a negative predictor ($\beta = -.26, p < .01$). Moreover, the variance explained in autonomous motivation increases to 47%. As such, competence satisfaction is negatively related to the variance in the participating teachers' autonomous motivation left unexplained by

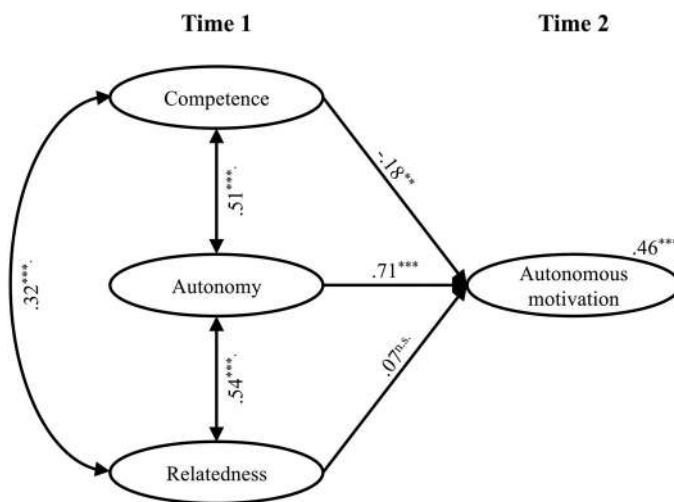


Figure 3. Standardised relationships between basic psychological need satisfaction and autonomous motivation for professional learning. n.s. = not significant. ** $p < .01$; *** $p < .001$.

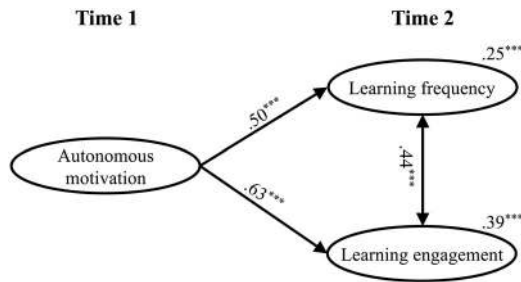


Figure 4. Standardised relationships between different types of motivation for professional learning and two measures of commitment to professional learning. *** $p < .001$.

autonomy satisfaction. As such autonomy satisfaction acts as a negative suppressor variable. We performed the same analyses for autonomy satisfaction and relatedness satisfaction together. In this model, the correlation between autonomy and relatedness satisfaction is also high ($r = .54, p < .001$). Autonomy satisfaction is a positive predictor ($\beta = .61, p < .001$) and relatedness satisfaction shows no significant relationship anymore ($\beta = .07, p = .34$). Moreover, the variance explained decreases to 42%. These results combined show that relatedness satisfaction does not give additional explanatory value in predicting autonomous motivation over autonomy satisfaction in the current sample. We would like to note here that these analyses were also performed with intrinsic motivation and identified regulation as separate dependent variables both across and within measurement occasions. These analyses led to the same conclusions.

Finally, Figure 4 shows that, in line with our hypothesis 1, autonomous motivation is significantly and strongly related to both the frequency with which teachers learn at work and the engagement with which they do so. The total amount of variance explained in the frequency with which teachers report to perform learning activities is 25%, while for their engagement in learning this is 39%.

Discussion

This study combined the JDR model and SDT to better understand how teachers' commitment to professional learning can be stimulated. Specifically, it investigated to what extent the effects of job demands and job resources on teachers' commitment to professional learning, as manifested by their learning frequency and engagement, can be explained through basic psychological need satisfaction and consequent autonomous motivation. Currently the JDR model does not include such a psychological mechanism that accounts for the respective effects of job demands and resources on professional learning (Schaufeli and Taris 2014). Results largely confirmed our expectation that job resources (i.e. task autonomy, transformational leadership of direct supervisors, and social support from colleagues) would be positively related to satisfaction of the basic psychological needs for autonomy, competence and relatedness. The anticipated negative relationship between job demands and basic psychological need satisfaction could not be confirmed. Basic psychological need satisfaction, in turn, was confirmed to positively predict autonomous motivation for professional learning, although only autonomy satisfaction made a unique contribution in this respect. Finally, autonomous motivation was confirmed to positively

relate to the frequency with which teachers report to perform learning activities and the engagement with which they do so. Together, these results show that basic psychological need satisfaction and autonomous motivation are not only important in explaining the effects of job resources on teachers' motivation for work in general (Fernet et al. 2012, 2013, 2016; Fernet, Austin, and Vallerand 2012; Van den Broeck et al. 2008), but also for their commitment to professional learning.

Implications for research and theory

In line with SDT and previous research on teachers' motivation for professional learning (Gorozidis and Papaioannou 2014; Jansen in de Wal et al. 2014), this study showed a strong and positive relationship between autonomous motivation for professional learning and teachers' reported performing of professional learning activities. The present study complements existing research by showing that autonomously motivated teachers do not only report to perform learning activities more often, but also report higher engagement (i.e. energy, effort, and engrossment) in their learning. This is also in line with the assumptions of SDT (Deci and Ryan 2000). We think that *how* teachers perform learning activities is important to address in future research in addition to how often teachers do so, because it may explain differences in learning results among teachers who perform the same amount of learning activities (cf. Vansteenkiste et al. 2009).

With respect to the relationship between basic need satisfaction and teachers' autonomous motivation for professional learning, a strong positive effect of autonomy satisfaction was found. Competence and relatedness satisfaction were positively related to autonomous motivation as well, but not over and above the effect of autonomy satisfaction. This result can be explained through the high intercorrelations between the three basic psychological needs. This shows that the satisfaction of all three needs is important, since they may also mutually influence each other and overlap in their effect on autonomous motivation (Deci and Ryan 2000). This may justify why previous research includes a 'general basic need satisfaction' construct in their analyses (Van den Broeck et al. 2008). In this study, we decided to analyse the effects of job demands and resources on the three basic needs separately because we formulated expectations about which resource would primarily affect each basic need. Therefore, we also included the separate effects of basic psychological needs on autonomous motivation. Nevertheless, we think that more research can be done regarding the nature of the combined effect of autonomy, competence, and relatedness satisfaction on autonomous motivation. Dysvik, Kuvaas, and Gagné (2013) studied these combined effects on intrinsic motivation and found that the effects of autonomy, competence and relatedness were additive and the effects of autonomy and competence were synergistic (i.e. interacted). It would be interesting to also investigate this for autonomous motivation.

The main issue under investigation in this paper concerned the connection between job demands, job resources and basic psychological need satisfaction. Regarding the effects of job demands, emotional pressure did not relate to any of the basic psychological needs for professional learning. Nevertheless, previous research (Evers et al. 2016; Kwakman 1998, 2003) and our own data consistently show that emotional pressure is moderately positively related to teachers' reported professional learning behaviour. This suggests that other mechanisms than the SDT dynamics included in this study may account for this

relationship. Perhaps other SDT variables, like need frustration (Chen et al. 2015) or controlled motivations can provide such an account. Alternatively, personal resources, (i.e. stable, protective individual characteristics of teachers), such as self-efficacy or resilience (Schaufeli and Taris 2014) could be important in this respect. Future research should address this issue.

Work pressure, the other job demand included in this study, did relate negatively to autonomy and relatedness satisfaction. However, this effect was not observed when task autonomy was also included as a predictor of basic psychological need satisfaction. This finding, in combination with the high negative correlation that was observed between work pressure and task autonomy, suggests that work pressure and task autonomy are two sides of the same coin in their effect on basic need satisfaction for professional learning. This, together with the findings regarding emotional pressure, challenges our suggested explanation for the effects of job demands on teachers' professional learning through basic psychological need satisfaction and autonomous motivation. However, a possible explanation for not finding negative effects of job demands on basic need satisfaction lies in the way that data was collected for this study. The voluntary nature of our sample may have caused a bias towards teachers who suffered less from job demands. This could have mitigated the effects of job demands on basic need satisfaction for professional learning in the current study. In fact, differences in sampling strategies between earlier studies may also have caused their mixed findings regarding effects of job demands on professional learning (Evers et al. 2016; Kwakman 2003; Morrison et al. 2005; Raemdonck, Gijbels, and van Groen 2014; Taris et al. 2003). Therefore, we suggest that future studies on the effects of job demands on professional learning (through basic psychological need satisfaction) invest considerable effort in randomly selecting schools for collecting data and achieving participation of all teachers working at those schools.

With respect to job resources, positive effects of task autonomy and transformational leadership on teachers' basic psychological need satisfaction for learning were observed. These effects were in line with our hypotheses. Only the effect of social support from colleagues did not contribute to relatedness satisfaction over and above transformational leadership. This could indicate that regular colleagues are less important in determining teachers' learning related basic need satisfaction. An alternative explanation, however, would be that some teachers experience their direct supervisors to be colleagues just like the other teachers they work with. In the Netherlands, teachers with leadership roles often still teach classes, just like the teachers they are supervising. This may have caused our measures of social support from colleagues and transformational leadership to overlap for some participants. Therefore, and because of the results regarding social support from colleagues when not taking transformational leadership into account, we conclude that this job resource can still be regarded as important for teachers' relatedness satisfaction. As such, our study indicates that the effect of job resources on teachers' professional learning can be explained through basic psychological need satisfaction and, consequently, autonomous motivation.

The finding that job resources affect teachers professional learning through basic need satisfaction and autonomous motivation provides a starting point to further refine and investigate both the JDR model and SDT in relation to teachers' professional learning. That is, the JDR model makes some assumptions that can be questioned based on SDT. For example, performance feedback and financial rewards are considered to be job

resources and hence stimulate teachers' learning (Schaufeli and Taris 2014). However, according to SDT, feedback will only contribute to autonomous motivation for learning when it is positive rather than negative and informational rather than controlling. Furthermore, financial rewards have been found to undermine autonomous motivation rather than stimulate it (Deci and Ryan 2000). As such, SDT provides hypotheses about conditions under which performance feedback should stimulate learning and questions whether financial rewards can be considered job resources in terms of their effect on learning. The investigation of both these issues can lead to the further specification and development of the JDR model based on SDT. Conversely, as SDT is a general psychological theory of motivation, it does not put forward any specific factors that promote or undermine teachers' basic psychological need satisfaction for professional learning. Based on this study, the job demands-resources model can be concluded to provide a substantial contribution in this respect.

Limitations

Although we established relationships over time between the consecutive variables in our theoretical model, we cannot draw conclusions about causal, total direct, or total indirect effects. As such, whether the relationship between job resources and teachers' commitment to professional learning is completely or partially explained by SDT remains a topic for further research with sample sizes that allow for testing more complex models (Cole and Maxwell 2003). Nevertheless, our design did allow presumed causes (e.g. challenging job demands and resources) to occur and be measured before presumed effects (e.g. basic need satisfaction). This quality of our data provides no definitive, but stronger support for causal relationships than cross-sectional designs (Kline 2011, 98).

Secondly, as this study included only self-report measures, common method bias may have influenced the outcomes of analyses. Again, cancelling out common method bias in our analyses would have required analysing models that are too complex for the size of the current sample (Cole and Maxwell 2003). More research, should be performed in order to account for the effects of using common methods in measuring job demands, job resources, basic need satisfaction, motivation for, and commitment to learning. In addition, more objective measures of teachers' commitment to professional learning as outcome variables could be used in future research. Reports by other informants can shed light on how engaged teachers are in professional learning beyond their own perceptions.

Finally, the range of job demands and job resources evidently goes beyond the constructs included in this study. Schaufeli and Taris (2014) sum up an extensive list of job resources that can contribute to teachers' basic need satisfaction, autonomous motivation for, and commitment to professional learning. We encourage future research to investigate the effects of these job resources on basic psychological need satisfaction and motivation to further support our conclusions.

Practical implications

Teacher professional learning is not always self-evident. Our findings provide important practical implications for school leaders who want to commit their teachers to professional

learning. In line with previous studies, our results indicate that this commitment benefits from job resources like school leader's transformational leadership practices (Geijsel et al., 2009; Runhaar, Sanders, and Yang 2010; Thoonen et al. 2011; Tuytens and Devos 2011), task autonomy (De Neve, Devos, and Tuytens 2015; Kwakman 1998), and a culture in which teachers provide each other with individual support in case of work-related problems (Evers, Kreijns, and van der Heijden 2015; Kwakman 2003). This study adds to the previous research by providing an explanation for these effects by relating job resources to basic psychological need satisfaction.

Insight in the mechanisms through which job resources influence teachers' learning can help explain why teachers vary in learning commitment, even though their working conditions are the same. That is, individual teachers' interests, goals, and values (autonomous motivations) may differ in content. For example, some teachers are primarily interested in learning about content matter, whereas others focus on pedagogy. This causes teachers to be engaged differently in various learning activities. As a consequence, school leaders should acknowledge differences in the content of teachers' autonomous motivations for learning and take them into account in the organisation and support of learning activities. This way, autonomous motivation for, and commitment to professional learning can be sustained among teachers. Moreover, school leaders should consider factors that have previously been identified to contribute to basic psychological need satisfaction in general, also outside the context of work. Feelings of autonomy decrease as a result of contingent tangible rewards, threats of being punished, being scrutinised and evaluated, competition, and having to meet deadlines. On the other hand, autonomy satisfaction may be enhanced by providing individuals with meaningful choices, providing meaningful rationales for requested behaviour, and acknowledging the inner experiences of others (Deci and Ryan 2000). Feelings of competence are strengthened by positive and relevant performance feedback (Deci and Ryan 2000). Finally, the need for relatedness is satisfied by environments that convey respect for the individual, making them feel valued and significant, and showing care and concern when the individual faces challenges. In addition to the provision of job resources, these factors are likely to contribute to teachers' autonomous motivation for, and commitment to professional learning.

Conclusion

In conclusion, this study contributes to a further understanding of how and why the work environment of teachers influences their professional learning behaviour. This not only helps educational practice to stimulate teachers' professional learning, but also provides research with insights that can improve reasoning on factors that should be related to teachers' professional learning.

Disclosure statement

No potential conflict of interest was reported by the authors.

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