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Teacher self-efficacy, instructional quality, and student motivational beliefs: An analysis using multilevel structural equation modeling

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Abstract

Teacher self-efficacy (TSE) is one of the most salient motivational characteristics that is assumed to affect teachers' instructional quality and student motivational beliefs. However, discussions of these associations have primarily been often primarily conceptual and/or based on empirical research that has suffered from methodological shortcomings. Therefore, the aim of this study was to examine the relationships between TSE, instructional quality (i.e., classroom management, cognitive activation, and supportive climate) and student motivational beliefs (i.e., self-efficacy and intrinsic motivation) by using responses from both teachers and students and implementing a sophisticated doubly latent multilevel structural equation modeling approach. A total of 94 high school teachers and their 2087 students participated in the study. The results demonstrated that, at the class level, TSE was positively related to the three dimensions of instructional quality but not to student motivational beliefs. As expected, instructional quality was positively related to student motivational beliefs.

Keywords: teacher self-efficacy, instructional quality, student motivational beliefs, doubly latent multilevel structural equation modeling

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1. Introduction

Teacher motivation is of key importance for both effective teaching and student learning (Kunter et al., 2008; Roth, Assor, Kanat-Maymon, & Kaplan, 2007). Among an array of motivational constructs, teacher self-efficacy (TSE) is recognized as a relevant predictor of teacher effectiveness (Klassen & Tze, 2014). TSE is directly related to certain aspects of instructional quality (e.g., Holzberger, Philipp, & Kunter, 2013; Ryan, Kuusinen, & Bedoya-Skoog, 2015; Künsting, Neuber, & Lipowsky, 2016) and is believed to shape student motivation and achievement (Klassen & Tze, 2014; Tschannen-Moran, Woolfolk Hoy, & Hoy, 1998; Zee & Koomen, 2016). Moreover, some researchers argue that TSE affects student outcomes indirectly, that is, through its effects on instructional practices (Guo, McDonald Connor, Yang, Roehrig, & Morrisson, 2012; Woolfolk Hoy & Davis, 2005). Furthermore, teachers' levels of instructional quality have been found to be related to student motivation (e.g., Fauth et al., 2014; Sakiz, Pape, & Woolfolk Hoy, 2011) as well as student learning and achievement (e.g., Hattie, 2009; Kunter et al., 2013).

Despite evidence on the above-described individual interrelationships between TSE, classroom processes, and student outcomes, a holistic process model including these associations have been primarily conceptual (e.g., Tschannen-Moran et al., 1998) rather than empirical (Zee & Koomen, 2016). In addition, many studies that examined the links between the different aspects of the classroom climate (e.g., instructional quality) and student outcomes have suffered from methodological flaws, such as failing to consider the appropriate level of statistical analysis and inadequately controlling for potential measurement and sampling errors (Morin, Marsh, Nagengast, & Scalas, 2014). Finally, past studies have often relied either on teacher or student self-reports instead of integrating the perspectives of both the teacher and the student. Therefore, the goal of the present study is to empirically expand our understanding of the nature of the associations between TSE, teachers' instructional practices, and students' motivational beliefs, while overcoming certain methodological issues that were present in previous research.

1.1. Teacher Self-Efficacy and its Associations with Teachers' Instructional Quality and Students' Motivational Beliefs

One of the premises of the social-cognitive theory (Bandura, 1977; 1997) is that human functioning involves a dynamic interplay of intrapersonal, behavioral, and environmental factors, which are linked to each other by a triadic reciprocal codetermination. Individuals are seen as agents who exert intentional influence over their functioning and the course of the events in their lives. Their agency is rooted in corresponding self-efficacy beliefs, which are affected by various behavioral and environmental factors; namely, through mastery experiences, vicarious experiences (i.e., social modeling), social persuasion, and physiological and emotional states (Bandura, 1997; 2012). Self-efficacy beliefs affect the quality of human functioning through cognitive, motivational, affective, and decisional processes. That is, these beliefs shape individuals' outcome expectations, causal attributions of successes and failures, and the ways individuals motivate themselves and preserve in the face of obstacles. In addition, self-efficacy affects individuals' beliefs in their coping capabilities, emotion regulation mechanisms, and vulnerability to stress and depression. Lastly, self-efficacy beliefs can influence the choices individuals make at important life points, therefore, potentially shaping the course of their lives and what they become (Bandura, 2012).

Self-efficacy beliefs are domain-specific, manifesting itself in different forms depending on the activity domain and situational condition (Bandura, 2012). In the teaching domain, TSE can be defined as teachers' beliefs in their capabilities to teach their subject matter and to accomplish desired outcomes of student engagement and learning even when teaching challenging students (Tschannen-Moran & Woolfolk Hoy, 2001). In general, individuals with high self-efficacy beliefs perform better at work since they tend to work harder, are more persistent, and experience lower levels of stress (Bandura, 1997). In this light, teachers with a strong sense of efficacy invest more time in planning, are better organized, are more open to new ideas and methods, show greater enthusiasm for teaching, and tend to be more persistent in working with struggling students (Tschannen-Moran & Woolfolk Hoy, 2001). Indeed, research indicate that TSE is related to various indicators of teacher performance, such as student academic achievement and student motivational beliefs (Klassen & Tze, 2014; Midgley, Feldlaufer & Eccles, 1989), as well as teacher instructional quality (Klassen & Tze, 2014; Klassen, Tze, Betts, & Gordon, 2011; Tschannen-Moran, Woolfolk Hoy & Hoy, 1998).

Contemporary conceptualizations of instructional quality stipulate that the effects of teachers and classrooms on student learning are achieved through the interactions between teachers and students. For example, the Teaching through Interactions Framework (Hamre et al., 2013) proposes there are three important domains of classroom teaching: classroom organization (which promotes positive behavior and attention), instructional support (which enhances learning), and emotional support (which promotes student social development). Similarly, according to the Three Basic Dimensions Framework (Praetorius, Klieme, Herbert, & Pinger, 2018), classroom management, cognitive activation, and supportive climate are critical for student learning and motivation. Classroom management encompasses one's ability to deliver well-structured and organized instructions as well as the ability to demonstrate effective student behavior management that ensure enough time for learning activities (Pianta & Hamre, 2009; Schlesinger & Jentsch, 2016) and promote both student learning and achievement (e.g., Seidel & Shavelson, 2007) as well as their motivation

(Rakoczy et al., 2007). Cognitive activation refers to one's ability to engage students in higher order thinking skills and challenging tasks, foster student in-depth understanding of the content, and stimulate explorations of concepts, ideas, and prior knowledge (Pianta & Hamre, 2009; Pianta et al., 2012; Schlesinger & Jentsch, 2016) and is related to student engagement in higher-level thinking processes and metacognition (Baumert et al., 2010). Lastly, supportive climate focuses on aspects of self-determination theory (Deci & Ryan, 1985) and refers to one's ability to demonstrate features of the teacher–student relationship, such as constructive feedback during instruction, positive approach to student errors and misconceptions, and caring behavior (Klieme, Pauli, & Reusser, 2009; Klieme et al., 2001). This dimension of instructional quality has been thought to enhance student well-being and learning motivation (Praetorius et al., 2018).

In their synthesis on 40 years of TSE research, Zee and Koomen (2016) concluded that teachers with high levels of self-efficacy tend to cope effectively with a range of problematic student behaviors in the classroom, use proactive and student-centered classroom behavior strategies, and create positive relationships with their students. In addition, the existing empirical evidence clearly supports the link between TSE and dimensions of instructional quality. For example, teachers with a strong sense of efficacy tend to create a supportive classroom environment (Guo et al., 2012; Künsting et al., 2016; Ryan, Kuusinen, & Bedoya-Skoog, 2015), deliver cognitively activating instructions (Holzberger et al., 2013; Künsting et al., 2016; Schiefele & Schaffner, 2015), and effectively organize classroom activities (Guo et al, 2012; Holzberger et al, 2013; Künsting et al, 2016; Ryan et al., 2015).

Student motivation can be viewed as a process through which goal-directed learning or achievement activity is instigated and sustained (Pintrich & Schunk, 1996). According to a social-cognitive view on motivation, motivational beliefs, values, and goals are of critical importance in this process (see Eccles & Wigfield, 2002 for a review). For instance, the expectancy-value theory of achievement motivation (Wigfield & Eccles, 2000) posits that students' choices, persistence, and performance in an activity can be explained by their motivational beliefs. That is, their confidence, expected performance, and the perceived value of the activity (i.e., attainment value, intrinsic value, utility value, and cost) can influence their level of engagement and persistence in an activity. Student expectancies and values are shaped by factors, such as their goals, self-schemata, and perceptions of task demands, which are rooted in the perceptions of their own previous experiences and a variety of socialization influences (Wigfield & Eccles, 2000). Therefore, teachers (and their instructional behaviors) can have important roles in shaping students' motivational beliefs, namely expectancies and values. More specifically, ensuring that students are being attentive and receive adequate cognitive stimulation and opportunities for success along with fulfilling their needs in a self-determined way, may boost their confidence levels and expectancies for success as well as the subjective value they ascribe to the learning tasks.

In the present study, the expectancy component of student motivation is conceptualized through self-efficacy (Bandura, 1997) and the value component is conceptualized through intrinsic motivation, that is, performing an activity to experience pleasure and satisfaction that are inherent to the activity (Deci & Ryan, 1985). Intrinsic motivation is a construct very similar to intrinsic value component in the expectancy-value model of achievement, which can be described as enjoyment a student experiences while performing the activity or the subjective interest the student has in the subject (Eccles & Wigfield, 2002). Both of these motivational beliefs are of great importance for student academic outcomes — student beliefs about their ability and expectancies for success strongly predict academic achievement, while student subjective values predict domain-specific (career) aspirations (Guo, Marsh, Parker, Morin, & Dicke, 2017; Lauermann Tsai, & Eccles, 2017; Wang, Eccles, & Kenny, 2013; Wigfield & Eccles, 2000). The focus of the present research was on high school students enrolled in grammar school programs that best prepare students for pursuing higher education at universities. Therefore, investigating the teacher and classroom characteristics that may explain their ability and value beliefs is of crucial importance for understanding their future academic success and career choices.

It was suggested that TSE influences student motivation. That is, teachers with greater sense of efficacy provide their students with more choices, transfer greater confidence, and provide students with a greater sense of control of their learning, which in turn positively affect students' engagement in class activities, their learning values, and confidence (Woolfolk Hoy, Hoy, & Davis, 2009). Indeed, some research suggests that TSE may be directly and positively related to different aspects of student motivation, such as engagement, on-task behavior, and invested effort, as well to student motivational beliefs like expectancies, self-efficacy, intrinsic value, and attitudes towards learning (e.g., Midgley, Feldlaufer, & Eccles, 1989; Reyes et al., 2012; Ross, 1998; see Zee & Koomen, 2016 for a review). However, most of this research, with an exception of Midgley et al.'s study, were either based on small samples and cross-sectional designs, relied solely on a self-report method, and/or failed to analyze these associations at an appropriate level (i.e., teacher level). For instance, when taking into account both teachers' and students' responses and acknowledging the multilevel structure of such data, TSE was not related either to student-reported school investment or to student motivational beliefs, such as self-efficacy, intrinsic values, and goal orientations (Thoonen, Sleegers, Peetsma, & Oort 2011). Due to the scarcity and inconsistency of existing empirical evidence, as well as the methodological shortcomings of previous research, further elucidation of the link between TSE and student motivation is warranted.

1.2. The Association Between Instructional Quality and Student Motivational Beliefs

Teacher instructional quality has been acknowledged as an important source of variation in student learning and achievement (Creemers & Kyriakides, 2008; Hattie, 2009). The different dimensions of instructional quality not only explain student cognitive outcomes (e.g., Fauth et al., 2014; Kunter et al., 2013; Riconscente, 2014), but also affect student motivational beliefs (e.g. Fauth et al., 2014; Sakiz, Pape, & Woolfolk Hoy, 2011; Schiefele & Schaffner, 2015). For example, according to the Teaching through Interactions Framework and the Three Basic Dimensions Framework (Klieme & Rakoczy, 2003; Praetorious et al., 2018), providing support to students is expected to foster student intrinsic value beliefs. More precisely, creating a supportive classroom climate that can fulfill students' basic intrinsic needs (i.e., relatedness, autonomy, and competence; Ryan & Deci, 2000) should have positive effects on student intrinsic motivation and subject-related interest (Kunter, Baumert, & Köller, 2007). In addition, providing meaningful and adequately challenging learning tasks that promote learning goals and ensuring mastery experiences (which may be achieved through cognitive activation dimension of instructional quality) are expected to promote student intrinsic motivation (Lepper & Henderlong, 2000). Lastly, since efficient classroom management ensures that students are attentive and are being offered opportunities for learning without disruptions and disturbances, it may foster student motivation as well (Praetorius et al., 2018).

Indeed, Sakiz, Pape, and Woolfolk Hoy (2011) found that perceived teacher affective support was positively related to student academic enjoyment, self-efficacy, and effort in mathematics. Moreover, studies show that other dimensions of instructional quality, namely, cognitive activation and classroom management, are also related to student value beliefs. For instance, Fauth et al. (2014) found that students instructed by teachers who are seen as more supportive and more cognitively activating, are in general more interested in taught subject. In addition, in the same study, classroom management was also positively related to student interest, but only at the student level of analysis. Similarly, Dorfner et al. (2018) found positive total effects of all three dimensions of instructional quality on student situational interest. Lastly, Kunter et al. (2013) found both learning support and classroom management had positive effects on students' mathematics enjoyment which, along with interest, positively contribute to the processes of intrinsic motivation (Reeve, 1989). These results clearly indicate that all three dimensions of instructional quality (and not only supportive climate) may be important for student intrinsic motivation. However, they also indicate that some of these effects could be mediated by third variables. For instance, Dorfner et al. (2018) found that cognitive activation mediates the effects of classroom management and supportive climate on situational interest.

Empirical evidence regarding the effects of the three dimensions of instructional quality on student self-efficacy (SSE) beliefs is relatively scarce. Aligned with the social-cognitive theory (Bandura, 1997), SSE beliefs should rise from one's previous performance, but also from observing others (e.g., observing classmates succeeding in a task), verbal persuasion (e.g., encouragement and support from teachers), and interpretation of one's physiological states (e.g., anxiety and stress may signal the lack of needed skills to succeed; Zimmerman, 2000). Therefore, teacher behavior in the classroom is highly relevant for the development of SSE. More specifically, teachers who are more supportive of their students, who manage classrooms more efficiently, and who are more able to stimulate deep levels of cognitive processing and engagement in a subject, are expected to provide students with generally more sources for greater SSE. That is, they offer their students more opportunities for achievement and mastery experience, have more credibility in persuading them that success is attainable, and are able to maintain low levels of stress and anxiety in the classroom (Bandura, 1997; Schunk & Pajares, 2009). Indeed, Fast et al. (2010) found that students who perceived their classroom environments as more caring, challenging, and mastery-oriented reported significantly higher levels of SSE. Furthermore, Riconscente (2014) revealed that teacher caring, content explanations, and interest promotion play an important role in explaining both student interest and SSE beliefs. In addition, students who view their learning environment as supportive for their autonomy reported higher levels of self-esteem and perceived competence (Ryan & Grolnick, 1986).

1.3. The Present Study

TSE is recognized as an important motivational variable that influences teacher effectiveness (Klassen & Tze, 2014). The existing literature indicates that TSE shapes teacher instructional practices (e.g., Guo et al., 2012; Künsting et al., 2015; Ryan et al., 2015; Tschannen-Moran & Woolfolk Hoy, 2001) and is related both to students' academic achievement (Caprara, Barbaranelli, Steca, & Malone, 2006; Klassen & Tze, 2014), and student motivation (e.g., Midgley et al., 1989; Ross, 1998; Tschannen-Moran et al., 1998). In addition, teacher instructional quality was recognized as important positive predictor of student motivational beliefs (e.g. Fauth et al., 2014; Sakiz, Pape, & Woolfolk Hoy, 2011; Schiefele & Schaffner, 2015).

However, the existing knowledge on the relationships between TSE, instructional quality, and student motivational beliefs is still rather fragmented and inconsistent. Some of these inconsistencies may be attributable to different methods used for assessing the constructs of interest across studies (e.g., videotaping teacher instructions in Dorfner et al.'s (2018) study as opposed to using only teacher-reports in Künsting et al.'s (2016) study) or even to different levels of conceptualization and measurement of constructs (Zee, Koomen, & de Jong, 2018). Moreover, some of the most cited papers on the importance of TSE for student motivation (e.g., Tschannen-Moran et al., 1998) were theoretical rather than empirical in its nature (Zee & Koomen, 2016), thus leaving the association between TSE and student motivational beliefs to be mostly empirically unestablished fact. Next, the majority of studies that examined the link between TSE and student outcomes solely relied on teacher reports (Zee & Koomen, 2016) and were, therefore, possibly burdened with a bias of overestimation of the size and statistical significance of the examined associations due to a common method variance (Podsakoff, MacKenzie, & Podsakoff, 2013). In addition, many earlier educational studies failed to examine the relationships between TSE, instructional quality, and student motivational beliefs at an appropriate level of analysis. More specifically, in many previous studies, true classroom-level climate constructs (e.g., instructional quality and teacher enthusiasm) have been treated as individual student constructs, which is based on an implicit assumption that the effects observed at one (student) level can be generalized to another (classroom or teacher) level. Such analytical strategies typically lead to confounding the true effects from individual students and classrooms as well as to biased estimates (Morin et al., 2014).

Within the present study, the relationship between instructional quality and student motivational beliefs is considered a classroom climate effect (instead of an individual student effect) since students were asked to evaluate the same objective classroom or teacher characteristic, that is, teachers' instructional quality. Accordingly, instructional quality should be based on individual student responses by aggregating them at the teacher level of analysis, and, thus, the relationships between instructional quality and other student motivational beliefs should also be tested at the teacher level (for more information, see Marsh et al., 2012; Morin et al., 2014). In other words, proper disaggregation of the individual and classroom (or teacher) components of the hypothesized relationships between instructional quality and student motivational beliefs and analyzing these relationships at the appropriate level are necessary to calculate accurate estimates. Lastly, in many previous investigations, sampling and measurement errors were not controlled for, which may have led to biased estimates of the obtained effects (Morin, et al., 2014).

To overcome these issues, the present study employed a multilevel design (i.e., students were nested within teachers) and used data from both teachers and students to test the proposed relationships between TSE, instructional quality, and student motivational beliefs. More precisely, in order to assess the climate effect of instructional quality, each student within a class directly rated the instructional quality of their teacher, thus making the teacher (rather than the student) the referent (Morin et al., 2014). Moreover, we used student-reports of instructional quality as opposed to teacher self-reports in order to reduce the likelihood of bias due to common-method effects and self-serving strategies that might be used by teachers (Schiefele & Schaffner, 2015). Student-reports are easily accessible and can provide a valid information on instructional quality (Scherer & Gustafsson, 2015; Wagner et al., 2013). Finally, we employed a doubly latent multilevel modeling technique (ML-SEM) in order to test the hypothesized relationships at proper level (i.e., classroom or teacher) of analysis and to control the measurement error (by using multiple indicators of the constructs at both student and teacher levels) and sampling error (by incorporating the scores for different students in the same class as multiple indicators of latent teacher level constructs; Marsh et al., 2012; Morin et al., 2014).

Based on theoretical assumptions and prior research, it can be assumed that teacher self-reported levels of self-efficacy would be positively related to class-reported levels of all three dimensions of instructional quality (H1). However, due to the scarcity and inconsistency of available findings on the relationship between TSE and students' motivational beliefs, we leave the nature of the association TSE has with SSE and intrinsic motivation as an open question (H2). Lastly, we expect that class-reported levels of instructional quality will be positively related to class-reported levels of motivational beliefs (i.e., positive climate effect of instructional quality on SSE and intrinsic motivation; H3).

2. Method

2.1. Participants and Procedure

The present study was part of a larger research project aimed to investigate teachers' emotion and emotion regulation, its antecedents, and effects on various aspects of teacher functioning (Burić, 2019; Burić & Frenzel, 2019; Burić & Macuka, 2018; Burić, Slišković, & Macuka, 2018; Burić, Slišković, & Penezić, 2019a,b; Burić, Penezić, & Sorić, 2017; Kim & Burić, 2019; Slišković, Burić, & Macuka, 2017). It was approved by an institutional ethics board at the university of the first author. A convenience sample of 94 high school teachers (86% female) from eight state high schools in Croatia and their 2087 students (one class per teacher) participated in the study. The teachers were 44.12 (*SD* = 9.07) years old and had 15.68 (*SD* = 9.31) years of teaching experience, which reflects typical gender and age structure of teachers in Croatia (OECD, 2015). They taught a range of subjects (e.g., Croatian and foreign languages; mathematics, physics, chemistry, biology, ICT, history, and geography). Students (57% female) were on average 16.81 (*SD* = 0.91) years old. The majority of them (82%) were enrolled in a grammar-school program.

Data was collected at a single time point via the administration of paper-and-pencil questionnaires, which were distributed to the students and the teachers with the assistance of school psychologists and returned to the researchers by post. As indicated above, this study was part of a larger research project; therefore, data on additional variables were also collected. Both teachers and students needed approximately 30 to 45 minutes to complete the questionnaires. Students completed the questionnaires during class time and teachers completed them during their free time. The participation in the study was anonymous and voluntary. More specifically, all the teachers from the eight schools were approached and invited to participate in the study, and only those who voluntarily agreed were enrolled in data collection procedure (the average response rate was 50%). Teachers gave self-reports on their levels of self-efficacy, while students reported the perceived levels of the three dimensions of instructional quality (i.e., classroom management, cognitive activation, and supportive climate) delivered by their teacher (i.e., target teacher) as well as self-reports on their own levels of self-efficacy and intrinsic motivation in the target teacher's subject. Each student reported on the characteristics of only one teacher. On average, reports from 22 students were obtained per teacher.

2.2. Measures

TSE was assessed through the Teacher Self-efficacy Scale (TSE; Schwarzer, Schmidt, & Daytner, 1999) which contains 10 items measuring teachers' perceptions of their efficacy in four areas of the teaching job: (1) job accomplishment, (2) skill development, (3) social interactions with students, and (4) coping with job stress. Teachers rated the agreement with each item on a 4-point scale ranging from 1 (not at all true) to 4 (exactly true).

Student-reported dimensions of instructional quality were measured using three corresponding scales. Classroom management was assessed through three items of the Monitoring scale (Kunter et al., 2008) and one additional newly created item. To efficiently capture the construct of cognitive activation in different academic domains, four items were taken from the Teacher Mastery Goal subscale of the Patterns of Adaptive Learning Scale (Midgley et al., 2000). In addition, four new items were developed. Students rated the classroom management and cognitive activation dimensions of their teachers' instructional quality on a 5-point scale ranging from 1 (completely disagree) to 5 (completely agree). Lastly, six items from the Learning Climate Questionnaire (Williams & Deci, 1996) was used to measure the supportive climate aspect of instructional quality. Students rated their agreement with each item on a 7-point scale ranging from 1 (strongly disagree) to 7 (strongly agree).

Student self-reported motivational beliefs were assessed using two measures. The first was the Self-efficacy for Learning and Achievement scale from the Motivated Strategies for

Learning Questionnaire (Pintrich, Smith, Garcia, & McKeachie, 1993), which is comprised of eight items assessing expectancy component of motivation (i.e., performance expectations and judgments of one's ability to master the task). Students rated the agreement with each item using a 5-point scale ranging from 1 (not at all true for me) to 5 (very true of me). The second measure was the Intrinsic Motivation subscale of the Situational Motivation Scale (Guay, Vallerand, & Blanchard, 2000), which contains four items describing intrinsic reasons for learning the subject taught by the target teacher. Students were instructed to rate the accuracy on the reasons why they were studying the subject taught by the target teachers on a 7-point scale ranging from 1 (not at all) to 7 (exactly).

The full list of items used in this research is shown in Appendix A. The Cronbach alphas and descriptive statistics for all the scales are presented in Table 1.

2.3. Analysis

Data in the current study were hierarchically structured—students located at Level 1 (L1) were nested within teachers located at Level 2 (L2). In such designs, L1 constructs (i.e., students' ratings of instructional quality and student motivation) are based on responses of individual students, while L2 constructs can be based on either true L2 measures (i.e., TSE) or aggregates of student responses within the class (i.e., aggregated ratings of instructional quality and class-average reports of motivational beliefs; Marsh et al., 2012). The effect of aggregated ratings of instructional quality on the class-average motivational beliefs is considered a climate effect since the referent is the class and each student in the class is asked to directly rate the same features of the classroom environment (i.e., teacher instructional quality) rather than to rate themselves in that environment. Since climate effects reflect the students' shared perceptions of their classroom environment, any residual inter-individual differences that occur at the student level once shared perceptions are controlled for are considered to be a source of unreliability (i.e., measurement error; Arens, Morin, &

Watermann, 2015; Marsh et al., 2012). These residual L1 ratings represent unique perceptions of each student that cannot be explained by the class-shared perceptions but may play a substantive role in the interpretation of the results (Morin et al., 2014).

In order to test the study hypotheses, we used a doubly latent multilevel structural equation modeling (ML-SEM; Marsh et al., 2009). The advantages of doubly latent ML-SEM are the ability to control for measurement error at both L1 and L2 levels by using multiple indicators of a construct, as well as the ability to control for sampling error through the aggregating individual student responses to represent teacher level characteristic (Morin et al., 2014).

The analysis was conducted in several steps. First, the intraclass correlation coefficients (i.e., ICC1 and ICC2) were obtained to evaluate the extent to which students of the same teacher shared similar perceptions of instructional quality and had similar levels of motivation. ICC1 denotes the proportion of the total variance occurring at the class level and ICC2 refers to the degree of agreement between students or the reliability of the group average (Lüdtke, Marsh, Robitzsch, Trautwein, 2011). It is suggested that ICC1 values should be close to or exceed .10, while ICC2 values should be higher than .70 (Lüdtke et al., 2011; Marsh et al., 2012). Second, the Pearson correlation coefficients between demographics and study variables were calculated at both student (L1) and teacher (L2) levels. Third, a multilevel confirmatory factor analysis (ML-CFA) was performed to test the latent structure of the used measures and to examine their validity. Scale items were used as indicators of each of the latent variables. To facilitate interpretation and to reduce nonessential multicollinearity, all variables in the model were standardized (M = 0.00, SD = 1.00; Arens et al., 2015; Morin et al., 2014). In addition, to ensure the comparability of the constructs across levels, the invariance of the factor loadings was tested. Such a procedure reduces the complexity of the model and yields more accurate parameter estimates at L2

(Morin et al., 2014). Fourth, the fit of the structural model was evaluated (see Figure 1), which hypothesized positive relationships between TSE and aggregated reports of instructional quality at L2, positive relationships between TSE and aggregated reports of motivational beliefs at L2, and positive relationships between residual student-reports of instructional quality and motivational beliefs al L1.

- FIGURE 1 -

The analyses were performed using Mplus 8.0 (Muthén & Muthén, 1998-2017) and based on robust maximum-likelihood estimator (MLR). Full information maximum-likelihood estimation (FIML; Enders, 2010) was employed to handle the missing data at the item level: 3% cognitive activation, 2.6% student self-efficacy, 1.5% classroom management, 1.1% intrinsic motivation, and 0% TSE. Goodness of model fit was evaluated by comparative fit index (CFI), Tucker-Lewis index (TLI), root-mean-square error of approximation (RMSEA), and standardized root-mean-square residual (SRMR). The following cutoff scores were used to indicate excellent and adequate fit: CFI and TLI ≥ .95, RMSEA ≤ .06 and ≤. 08, and SRMR ≤ .08 (Hu & Bentler, 1999; Morin et al., 2014). To compare the nested models, ΔCFI ≤ .01 and ΔRMSEA ≤ .015 criteria were used, and models with lower values were preferred (Chen, 2007; Cheung & Rensvold, 2002). We also reported AIC, BIC, and ABIC values, and lower values represent better fit to the data.

3. Results

Intraclass and Pearson correlations between the study variables are presented in Table 1. All ICC1 and ICC2 values exceeded the cutoff values of .10 and .70, respectively. These findings demonstrated that there were substantive amounts of total variance occurring at L2 as well as at L1, indicating that students' ratings showed reasonable levels of agreement (Lüdtke et al., 2011). The correlation coefficients between teacher (i.e., gender and years of teaching experience) and student demographic characteristics (i.e., gender and age) and the study variables were calculated at both levels of analyses.

As shown in Table 1, only years of teaching experience exhibited significant negative correlations with TSE, cognitive activation, classroom management, and SSE at L2. Therefore, years of teaching experience were introduced in the hypothesized model as a control variable at L2. The latent and manifest correlations at L2 showed that TSE positively correlated with all three aggregated dimensions of instructional quality (H1), but not with aggregated SSE and intrinsic motivation (H2). Next, aggregated student-reports of the three dimensions of instructional quality were positively related to aggregated student self-reported motivational beliefs, that is, with SSE and intrinsic motivation (H3)

Furthermore, the latent and manifest correlations calculated at both levels were in line with our expectations. Specifically, at L2, TSE positively correlated with all three aggregated dimensions of instructional quality (H1), while its correlations with aggregated SSE and intrinsic motivation were non-significant (H2). Next, aggregated students' ratings of dimensions of instructional quality were positively related to aggregated students' motivational beliefs (H3). At L1, students' residual ratings of the dimensions of instructional quality positively correlated to SSE and intrinsic motivation, indicating the existence of systematic differences in residual L1 climate ratings (Marsh et al., 2012).

- TABLE 1 -

We ran series of ML-CFAs to test the latent structure of each scale that was used to represent certain constructs at L1 and L2 (i.e., classroom management, cognitive activation, supportive climate, SSE, and intrinsic motivation). These analyses yielded satisfactory levels of fit for all the scales supporting their unidimensional structure. The specific results of these analyses can be found in Appendix B. Next, we tested the measurement model containing all constructs under study, represented by its respective items, and found a reasonable fit to the data: $\chi^2(990) = 3774.058$, CFI = .919, TLI = .912, RMSEA = .037, $SRMR_W = .036$ and $SRMR_B = .089$, AIC = 128383.904, BIC = 129484.757, ABIC = 128865.221. Moreover, factor loadings were in the acceptable range for all variables at L1 (.503 – .717 for classroom management, .591 – .756 for cognitive activation, .729 – .784 for supportive climate, .590 – .827 for SSE, and .695 – .866 for intrinsic motivation) and L2 (.716 – .980 for classroom management, .796 – .984 for cognitive activation, .905 – .994 for supportive climate, .710 – .994 for SSE, .916 – .999 for intrinsic motivation, and .563 – .727 for TSE).

However, as can be seen in Table 1, the latent correlations between the three dimensions of instructional quality were high in magnitude, indicating poorer discriminative validity of student-ratings (Lance, La Pointe, & Stewart, 1994). Therefore, to reduce the likelihood of issues caused by multicollinearity and model complexity, we tested separate models for each of the dimensions of instructional quality (i.e., classroom management, cognitive activation, and supportive climate) in three steps: (1) an unconstrained measurement model (M1), (2) a constrained measurement model (factor loadings set to be equal across levels; M2), and (3) a hypothesized structural model with years of teaching experiences as control variable at L2 (M3). The results are shown in Table 2. Based on the fit indices, all three measurement models seemed to show a reasonable fit to the data. Moreover, the assumption regarding the invariant factor loadings across the levels was satisfied for each of the models (ΔCFI = .003 and ΔRMSEA = .000 for M1, ΔCFI = .002 and ΔRMSEA = .000 for M2, ΔCFI = .004 and ΔRMSEA = .001 for M3). Finally, the structural models also yielded adequate to excellent fit. The standardized effects and their corresponding standard errors obtained in structural models are presented in Table 3.

- TABLE 2 –

- TABLE 3 -

At L2, higher levels of TSE showed positive associations with all three dimensions of instructional quality (i.e., classroom management, cognitive activation, and supportive climate), which was in line with H1. That is, teachers with higher levels of TSE were, on average, rated by students as managing classrooms better ($\beta = .255$, $p = .041$), providing more cognitive activation ($\beta = .261$, $p = .033$), and showing greater support ($\beta = .234$, $p = .035$). In regards to H2, TSE was not related to SSE and intrinsic motivation in classroom management, cognitive activation, and supportive climate models ($\beta = -.094$, $p =.447$ and $\beta = -.171$, $p = .137$; $\beta = -.083$, $p = .497$ and $\beta = -.168$, $p = .165$; $\beta = -.091$, $p = .469$ and $\beta = -.139$, $p = .296$, respectively). Next, in support of H3, in classes of teachers with higher levels on the three instructional quality domains (i.e., classroom management, cognitive activation, and supportive climate), the students reported higher levels of SSE ($\beta = .361$, $p = .001$; $\beta = .312$, $p = .016$; and $\beta = .384$, $p = .003$, respectively) and intrinsic motivation ($\beta = .539$, $p < .001$; $\beta = .510$, $p < .001$; and $\beta = .446$, $p < .001$, respectively). The results also revealed that more experienced teachers reported lower levels of TSE ($\beta = -.239$, $p = .029$; $\beta = -.244$, $p = .028$; and $\beta = -.242$, $p = .028$, for each of the models respectively). Lastly, the more experienced teachers were rated as poorer classroom managers by their students ($\beta = -.217$, $p = .055$) and had classes of students with somewhat lower levels of SSE ($\beta= -.178$, $p = .093$; $\beta = -.210$, $p = .040$; and $\beta = -.205$, $p = .052$, respectively). At L1, students' residualized perceptions of classroom management, cognitive activation, and supportive climate were positively related to SSE ($\beta = .351$, $p < .001$; $\beta = .427$, $SE = 0.026$, $p < .001$; and $\beta =.334$, $p < .001$, respectively) and intrinsic motivation ($\beta = .442$, $SE = 0.031$, $p < .001$; $\beta = .483$, $SE = 0.025$, $p < .001$; and $\beta = .363$, $SE = 0.030$, $p < .001$, respectively).

4. Discussion

The aim of this study was to examine the relationships between TSE, instructional quality, and student motivational beliefs by implementing a multilevel design and by collecting reports from both teachers and their students. Doubly latent ML-SEM was used, which allowed us to control for both measurement and sample errors, and thus yielding more accurate estimates of the relationships between the examined constructs. Moreover, the design of this study enabled us to examine the climate effect of teacher instructional quality on student motivational beliefs at an appropriate level of analysis.

4.1. Teacher Self-Efficacy and its Associations with Teachers' Instructional Quality and Students' Motivational Beliefs

As expected, the analysis showed that TSE was positively correlated to each of the three dimensions of instructional quality. Teachers with higher levels of self-efficacy were perceived by their students as someone who was more effective in classroom management, who stimulated higher levels of cognitive engagement among students, and who was more supportive. These results are in accordance with previous research that found positive associations between TSE and effective classroom management (Guo et al., 2012; Holzberger et al., 2013; Künsting et al., 2016; Ryan et al., 2015), creating a supportive climate in the classroom (Guo et al., 2012; Künsting et al, 2016; Ryan et al., 2015), and delivering cognitively activating instructions (Holzberger et al., 2013; Künsting et al., 2016; Schiefele & Schaffner, 2015). The current study findings also support the propositions of the social-cognitive theory (Bandura, 1997), which stipulate that individuals with higher self-efficacy beliefs perform better, which is achieved through hard work, persistence, and lower levels of stress. Indeed, teachers' expectations and confidence in their capabilities to accomplish teaching goals and desired student outcomes were reflected in their greater levels of effectiveness, that is, higher students' perceptions of instructional quality.

Next, the test of our second hypothesis showed that TSE was not directly related to the student motivational variables in the present study, which is in contrast to some earlier propositions (e.g., Ashton & Webb, 1986; Ross, 1998; Tschannen-Moran et al., 1998) but consistent with Thoonen et al.'s (2011) finding. It seems that when combining teacher self-reports with student-reports and analyzing the relationships at an appropriate level of analysis (i.e., teacher), the relationship between TSE and student motivational beliefs is not as robust as it has been previously suggested. Indeed, as noted by Zee & Koomen (2016), the most-cited papers (e.g., Tschannen-Moran et al., 1998) were theoretical papers that only assumed associations between TSE and student motivational beliefs instead of empirically testing them. In addition, some authors claim that TSE shapes student outcomes indirectly through the delivered instructional quality, thus implying a mediating role of teacher instructional behavior in explaining the relationship between TSE and student outcomes (Dembo & Gibson, 1985; Guo et al., 2012; Kunter et al., 2013; Woolfolk Hoy & Davis, 2005; Zee & Koomen, 2016). However, these claims were again in most cases derived either from theoretical considerations or from empirical findings based on a cross-sectional study design, which cannot accurately reveal underlying causal mediational mechanisms.

In line with the third hypothesis, aggregated student-reports of instructional quality were positively related to their motivational beliefs, namely self-efficacy and intrinsic motivation. Classes of students who gave their teachers higher ratings on all three dimensions of the instructional quality also reported higher levels of self-efficacy and intrinsic motivation. Interestingly, all three dimensions of instructional quality showed to be similarly relevant in explaining student motivation. According to the Teaching through Interactions framework (Hamre et al., 2013) and the Three Basic Dimensions of teaching quality (Praetorius et al., 2018), providing support to students is the most important factor for fostering student well-being and motivation, while classroom management and cognitive activation dimensions have the strongest role in facilitating student learning and achievement. However, our results showed that each of the three basic dimensions are similarly important in explaining student intrinsic motivation, which are in line with previous studies' findings (e.g., Dorfner et al., 2018; Fast et al., 2010; Fauth et al., 2014; Kunter et al., 2007; Riconscente, 2014). The obtained findings suggest that ensuring a supportive classroom climate may increase students' sense of personal autonomy and self-determination (Ryan & Deci, 2000), which then promotes their intrinsic motivation (Kunter, Baumert, & Köller, 2007). In addition, delivering instructions that are interesting and optimally challenging, as well as ensuring that students are being attentive and learning without disruptions, may enhance students' value beliefs (Lepper & Henderlong, 2000; Praetorius et al., 2018).

The observed patterns of the relationships between instructional quality and SSE are in accordance with the social-cognitive theory (Bandura, 1997), which posits that students' self-efficacy beliefs stem from actual performances, vicarious experiences, social persuasion and physiological and emotional states (Schunk & Pajares, 2009). Teachers' instructional behaviors can influence some of these sources of SSE. For instance, teachers who ensure students' attention to learning by efficient classroom management and who stimulate students to actively engage in knowledge construction also offer students more opportunities for mastery experience and success, which in turn boosts SSE. Moreover, such teacher behaviors can enable vicarious learning experiences for students since they can observe their class peers' task mastery behaviors. In addition, a supportive climate during learning and achievement activities may raise SSE through processes of social persuasion (e.g., providing positive feedback to students while ensuring that the envisioned success is attainable) and assist in maintaining low levels of stress and anxiety, which then promote the development of skills and competences in a safe environment and consequently enhance SSE levels.

At the student level, residual ratings of instructional quality dimensions were related to individual student differences in SSE and intrinsic motivation. Such residual climate ratings may play a substantive role in the interpretation of the results. For instance, systematic differences in residual L1 climate ratings may reflect systematic method effects — students may give consistently more or less favorable responses when rating the climate constructs (Marsh et al., 2012; Morin et al., 2014). Considering positive relationships between the residual ratings of the three basic dimensions and student motivation at L1, it is possible that students who are more motivated also tend to rate their teacher more favorably and vice versa. However, future studies with higher levels of methodological rigor (e.g., longitudinal designs and implementation of procedural remedies to control for common method bias; Podsakoff et al., 2012) are necessary to clarify these findings further.

4.2. Limitations and Future Directions

This research has several limitations. First, our study was based on a cross-sectional design, which does not avail itself to drawing any conclusions regarding the causal ordering of the examined constructs. That is, it is impossible to determine whether TSE is shaped by or influences the hypothesized outcome variables. Although the use of longitudinal data for future research is necessary, it may not be sufficient. For instance, although teacher motivation has mostly been conceptualized as an antecedent of instructional behaviors (e.g., Kunter et al., 2013; Zee & Koomen, 2016), findings from empirical studies based on longitudinal data have questioned whether it should be conceptualized as an antecedent construct. For example, in Künsting et al.’s (2016) study, which was based exclusively on teacher-reports, TSE was found to be a long-term predictor of instructional quality. In contrast, in Hozberger, Philipp, and Kunter’s (2013) study, which used data from both teachers and students, the reverse effect of instructional quality on TSE was found. That is, dimensions of instructional quality predicted TSE rather than the other way around. Finally, in Praetorius et al.’s (2017) study, based on longitudinal data from both teachers and students, revealed no significant cross-lagged effects between TSE and teaching quality when teachers’ stable characteristics were taken into account. Moreover, they found that TSE was quite stable among experienced teachers, with autocorrelations of up to .80, thus further complicating the determination of causal inferences (see e.g., Antonakis, Bendahan, Jacquart, & Lalive (2014) for further discussions). Nevertheless, longitudinal studies aimed at establishing the nature of the possible casual associations between the examined constructs are warranted. In addition, such studies would enable a test of the proposed indirect effect of TSE on student outcomes through instructional quality (Dembo & Gibson, 1985; Woolfolk Hoy & Davis, 2005; Zee & Koomen, 2016), which could not be achieved in the present research due to its cross-sectional design. Additionally, future studies should examine other teacher characteristics that are relevant for instructional quality using longitudinal data. In particular, besides TSE, teacher general and subject-specific pedagogical knowledge, beliefs, motivational orientations, and self-regulation skills should be considered in relation to their instructional quality and student motivational beliefs (Kunter et al., 2013; Lauermann & König, 2016).

Second, moderate to high correlations between different dimensions of instructional quality obtained in this study indicated relatively poor discriminative validity of student-ratings. Even though some studies demonstrated that the three-dimensional model of teaching quality can be replicated in student-ratings (e.g., Wagner et al., 2013), the current data suggest the insufficient capabilities of students to discriminate between different aspects of instructional quality. Nonetheless, the positive associations between TSE and the dimensions of instructional quality support the validity of student-ratings in assessing teacher instructional behaviors in the classroom to some extent.

Third, student-ratings of instructional quality may have been possibly affected by the perceived teacher popularity or grading practice (Aleamoni, 1999). Unfortunately, teacher popularity was not assessed in this study and, therefore, we could not test for a positive association between class perceived instructional quality and class motivation, after controlling for teacher popularity. However, previous research demonstrated that student-ratings of classroom management, cognitive activation, and supportive climate predicted student outcomes (i.e., achievement and subject-related interest), even after controlling the teacher popularity (Fauth et al., 2014).

Fourth, since students gave reports on both instructional quality and motivational beliefs, the size of the relationships between these two constructs may suffer from artificial inflation due to a common-method variance. Therefore, in future studies, much more care should be taken in implementing the most effective procedural and statistical remedies (e.g., using data from different sources, temporal separation of the predictor and criterion, eliminating common scale properties, direct measurement of latent method factor, measurement of response style; Podsakoff et al., 2012). In addition, future research should aim at collecting data from both teachers and students on the same constructs to obtain a more holistic picture of the antecedents and the effects of classroom processes.

Fifth, despite some empirical evidence showing that the dimensionality of instructional quality is invariant across school subjects (e.g., Sherer & Gustafsson, 2015), there are indications that not all domains of instructional quality ratings are invariant across subjects (Klieme, 2013; Wagner, Göllner, Helmke, Trautwein, & Lüdtke, 2013). More specifically, the cognitive activation dimension has predominately been developed in mathematics (e.g., Baumert et al., 2010) and may be less applicable to other subject areas. Unfortunately, due to a relatively small teacher sample size, academic subject specificity could not be statistically taken into account in the present study. However, the cognitive activation dimension was assessed through a newly created scale (see Appendix A) and special care was taken to choose and formulate items that would be applicable across a wide array of academic subject areas. Indeed, the high reliability coefficients and theoretically meaningful relations to other examined constructs found in this study show that cognitive activation can be successfully applied across multiple academic subject areas.

Lastly, the hypotheses in this study were tested only at the teacher level of analysis even though SSE and intrinsic motivation are inherently individual student constructs. However, since the referent in this study was the class rather than an individual student (i.e., all students within a class rated the same characteristic of their teacher), the effect of instructional quality on student outcomes was, by definition, a climate effect that must be tested at the teacher level of analysis. Nonetheless, future studies may wish to examine the contextual effect of instructional quality on student motivational beliefs where the referent is the individual student and not the class. This approach could also enable the test of this association at both the teacher and student levels of analyses (for more details, see Marsh et al., 2012).

4.3. Theoretical and Educational Significance

Although self-efficacy is an intra-personal variable that captures the core aspects of human agency (Bandura, 1997), it is also responsive to contextual influences (Klassen & Tze, 2014). For instance, it is established that students' self-efficacy may be influenced by different educational and instructional factors and can be even trained through specific instructional interventions (Shunk & Pajares, 2009; Zimmerman, 2000). Therefore, the results of this research have important educational implications for both teachers and their students. High-quality teacher education programs for pre-service teachers and professional development programs for in-service teachers could be aimed at fostering TSE in order to promote their instructional quality. In addition, training teachers to be competent classroom managers, to create supportive climate in the classroom, and to know how to stimulate higher-order thinking can foster student motivational beliefs. It was suggested that it may be helpful for teachers to familiarize themselves with the three-dimensional model of instructional quality (Klieme et al., 2001) and its effects on student outcomes within professional development programs (Dorfner et al., 2018). Lastly, raising teacher instructional quality may not only promote student outcomes, but also the sense of their own efficacy since these teaching behaviors also represent sources of self-efficacy for teachers. However, these suggestions should be viewed cautiously due to the cross-sectional design of the present study and the scarcity of research conducted with methodological rigor that allow making causal inferences regarding the interrelationships between TSE, instructional quality, and student motivational beliefs.

5. Conclusions

Findings from this research contribute to the scarce empirical evidence regarding the relationships between teacher motivational variables, their instructional behavios, and student outcomes. The obtained results emphasize the robustness of the positive link between teachers' self-efficacy and instructional quality even when these constructs are collected from different sources (i.e., teacher- and student-reports), but also question the existence of the often-assumed direct link between TSE and student intrinsic motivation.

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Appendices

Appendix A

Items of all the scales used in the study:

Cognitive activation

Our teacher…

1. ... gives tasks and asks questions that make us think.
2. ... wants us to understand our work, not just memorize it.
3. ... wants us to enjoy learning new things.
4. ... recognizes us for trying hard.
5. ... gives us time to really explore and understand new ideas.
6. ... stimulates us to think about the learning material.
7. ... makes sure that tasks really encourage us to think.
8. ... encourages us to persist until we figure the problem out.

Monitoring

Our teacher…

1. ... always knows exactly what is going on in the classroom.
2. ... makes sure that we pay attention.
3. ... immediately notices if we get distracted.
4. ... manages to hold our attention during a lesson.

Emotional support

Our teacher…

1. ... shows warmth to the students.
2. ... is aware of students' feelings.
3. ... cares about the problems of the students.
4. ... is empathetic towards students.

Student self-efficacy

1. I believe I will receive an excellent grade in this class.
2. I'm certain I can understand the most difficult material presented in the readings for this subject.
3. I'm confident I can understand the basic concepts taught in this subject.
4. I'm confident I can understand the most complex material presented by the teacher in this subject.
5. I'm confident I can do an excellent job on the assignments and tests in this subject.
6. I expect to do well in this class.
7. I'm certain I can master the skills being taught in this class.
8. Considering the difficulty of this subject, the teacher, and my skills, I think I will do well in this class.

Intrinsic motivation

Why are you engaged in this subject?

1. …Because I think that this subject is interesting.
2. …Because I think that this subject is pleasant.
3. …Because this subject is fun.
4. …Because I feel good when doing this subject.

Teacher self-efficacy

1. I am convinced that I am able to successfully teach all relevant subject content to even the most difficult students.
2. I know that I can maintain a positive relationship with parents even when tensions arise.
3. When I try really hard, I am able to reach even the most difficult students.

4. I am convinced that, as time goes by, I will continue to become more and more capable of helping to address my students' needs.
5. Even if I get disrupted while teaching, I am confident that I can maintain my composure and continue to teach well.
6. I am confident in my ability to be responsive to my students' needs even if I am having a bad day.
7. If I try hard enough, I know that I can exert a positive influence on both the personal and academic development of my students.
8. I am convinced that I can develop creative ways to cope with system constraints (such as budget cuts and other administrative problems) and continue to teach well.
9. I know that I can motivate my students to participate in innovative projects.
10. I know that I can carry out innovative projects even when I am opposed by skeptical colleagues.

Appendix B

The results of the ML-CFAs tests of 1-factor models for each scale separately

	Cognitive activation	Classroom management	Supportive climate	Student self-efficacy	Intrinsic motivation
χ^2 (df)	269.19 (40)	36.93 (4)	16.05 (4)	583.66 (40)	20.59 (4)
CFI	.955	.976	.996	.912	.994
TLI	.937	.928	.987	.877	.989
RMSEA	.052	.063	.038	.081	.045
$SRMR_W$	.031	.015	.011	.041	.011
$SRMR_B$	.051	.067	.008	.050	.015
AIC	38135.59	20666.55	17839.52	35241.19	18039.05
BIC	38361.38	20779.45	17952.42	35466.93	18151.92
ABIC	38234.30	20715.91	17888.87	35339.85	18088.38
λ_W (min-max)	.549-.791	.505-.716	.721-.778	.594-.827	.700-.875
λ_B (min-max)	.851-.999	.713-.977	.908-.995	.711-.998	.920-.997

Note. $_W$ = within (L1); $_B$ = between (L2); λ = standardized factor loading; all χ^2 values were statistically significant at $p<.001$

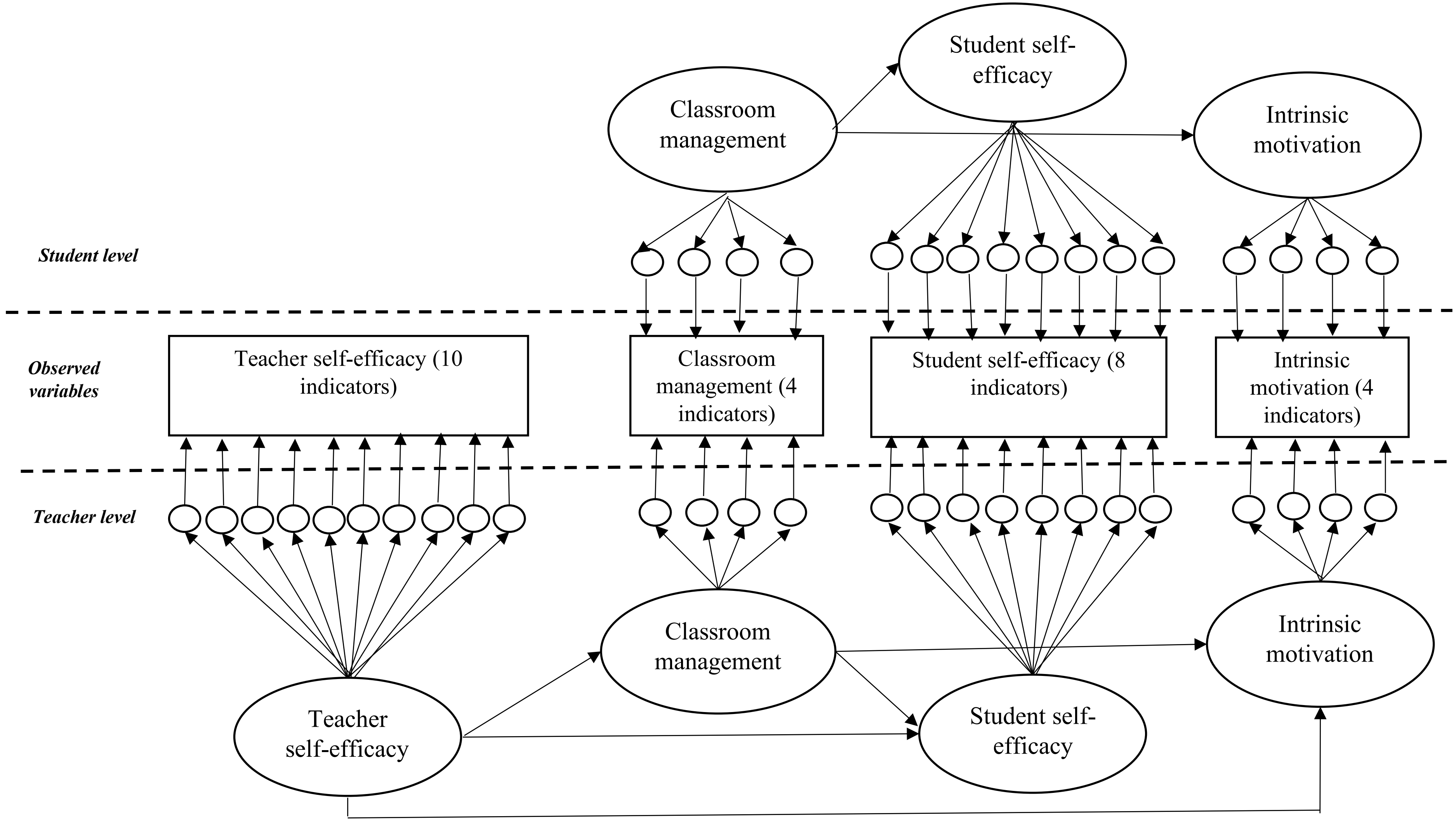

Figure 1. Hypothesized doubly latent multilevel SEM model.

Note. Only model for classroom management was depicted, but in total three separate models (for each of the dimensions of instructional quality) were tested.

Table 1

Descriptive statistics, intraclass correlations, and manifest and latent correlations between analyzed variables

	Variable name	1	2	3	4	5	6	7	8	9	10
1	Teacher gender	-	-	-	-	-	-	-	-	-	-
2	Teaching experience	.002	-	-	-	-	-	-	-	-	-
3	TSE	-.078	-.198*	[.87]	-	-	-	-	-	-	-
4	Student gender	.305	.204	.053	-	-.013	.023	.019	.038	-.009	.032
5	Student age	-.138	-.058	.158	-.107	-	.009	.006	.004	-.016	-.006
6	Classroom management	-.039	-.251*	.242* (.270*)	.032	.111	[.77]	.684** (.869**)	.583** (.723**)	.271** (.345**)	.316** (.428**)

7	Cognitive activation	.004	-.190†	.269*	.025	.097	.820**	[.90]	.714**	.378**	.417**
				(.303*)			(.836**)		(.820**)	(.421**)	(.478**)
8	Supportive Climate	.097	-.251*	.192*	.015	.170	.645**	.816**	[.90]	.289**	.314**
				(.225*)			(.618**)	.779		(.324**)	(.363**)
9	SSE	.147	-.168	.080	.104	-.006	.318**	.337**	.356**	[.93]	.460**
				(-.086)			(.350**)	(.274**)	(.320**)		(.508**)
10	Intrinsic motivation	-.051	-.130	-.005	-.166	-.098	.428**	.503**	.408**	.648**	[.90]
				(-.003)			(.534**)	(.473**)	(.419**)	(.691**)	
11	*M*	-	15.68	3.26	-	-	3.63	3.93	3.67	4.10	4.17
12	*SD*	-	9.31	0.38	-	-	0.84	0.77	0.92	0.84	1.58
13	ICC1	-	-	-	-	-	.29	.30	.27	.22	.19
14	ICC2	-	-	-	-	-	.90	.90	.89	.86	.81

Note. $^{\dagger}p<.10$, $^{*}p<.05$, $^{**}p<.01$; Cronbach's alphas are shown in the diagonal in rectangle parentheses; Correlations between Level 1 variables are shown above the diagonal; Correlations between Level 2 variables are shown below the diagonal; Latent correlations are shown below the manifest correlations in parentheses; TSE = teacher self-efficacy, SSE = student self-efficacy.

Table 2

Fit indices of the tested models

	Classroom management model			Cognitive activation model			Supportive climate model		
	M1	M2	M3	M1	M2	M3	M1	M2	M3
χ^2 (df)	1619.79 (394)	1687.81 (407)	1715.64 (439)	2191.51 (566)	2268.19 (583)	2306.42 (609)	1681.16 (394)	1826.77 (433)	1783.31 (429)
CFI	.930	.927	.925	.931	.929	.925	.935	.931	.929
TLI	.921	.920	.917	.924	.923	.919	.927	.925	.922
RMSEA	.039	.039	.039	.037	.037	.038	.040	.039	.040
$SRMR_W$	.040	.039	.039	.038	.037	.038	.040	.039	.040
$SRMR_B$	.078	.090	.092	.090	.094	.097	.072	.096	.086
AIC	75509.36	75571.79	71581.51	92788.32	92859.33	88114.94	72730.57	73451.01	69018.51
BIC	76181.16	76170.209	72196.61	93573.03	93548.07	88819.52	73402.37	74060.71	69633.61
ABIC	75803.08	75833.43	71847.14	93131.42	93160.46	88419.21	73024.30	73717.59	69284.31

Note. $_W$ = within (L1); $_B$ = between (L2); M1 = unconstrained measurement model; M2 = constrained measurement model (factor loadings set to be equal across levels); M3 = hypothesized structural model with years of teaching experiences as control variable at L2

Table 3

Standardized effects from the structural models

Classroom management model		Cognitive activation model		Supportive climate model	
Directional path	Standardized effect (SE)	Directional path	Standardized effect (SE)	Directional path	Standardized effect (SE)
L2 effects					
TSE → CM	.255 (.125)*	TSE → CA	.261(.122)*	TSE → SC	.234 (.111)*
TSE → SSE	-.094 (.124)	TSE → SSE	-.083 (.122)	TSE → SSE	-.091 (.125)
TSE → IM	-.171 (.137)	TSE → IM	-.168 (.121)	TSE → IM	-.139 (.133)
CM → SSE	.361 (.106)**	CA → SSE	.312 (.130)**	SC → SSE	.384 (.131)**
CM → IM	.539 (.116)**	CA → IM	.510 (.099)**	SC → IM	.446 (.113)**
EXP → TSE	-.239 (.110)*	EXP → TSE	-.244 (.111)*	EXP → TSE	-.242 (.110)*
EXP → CM	-.217 (.113)*	EXP → CA	-.147 (.114)	EXP → SC	-.132 (.120)
EXP → SSE	-.178 (.106)†	EXP → SSE	-.210 (.102)*	EXP → SSE	-.205 (.106)*
EXP → IM	-.035 (.106)	EXP → IM	-.077 (.091)	EXP → IM	-.093 (.099)
L1 effects					

CM (residualized) → SSE	.351 (.031)**	CA (residualized) → SSE	.427 (.026)**	CM (residualized) → SSE	.334 (.031)**
CM (residualized) → IM	.442 (.031)**	CA (residualized) → IM	.483 (.025)**	CM (residualized) → IM	.363 (.030)**

Note. †p<.10, *p<.05, **p<.01; TSE = teacher self-efficacy, CM = classroom management, CA = cognitive activation, SC = supportive climate, SSE = student self-efficacy, IM = intrinsic motivation, EXP = years of teaching experience