




Inspiring teacher creativity through leader-teacher exchange (LMX): a job demands-resources perspective

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Abstract

Following the Job Demands-Resources (JD-R) framework, this study examines the role of LMX in fostering teacher creativity. We proposed that teacher horizontal trust (job resource) would be related to teacher creativity through increased work engagement, and workplace stress (job demand) would be negatively related to teacher creativity through psychological strain and reduced engagement. Using a dataset of 5,053 teachers in 148 schools in Kyrgyzstan and employing several SEM models, the results showed that LMX was positively related to horizontal teacher-teacher trust but negatively associated with stress. A positive relationship was found between trust and engagement, as well as between stress and strain. While engagement was positively related to teacher creativity, the association between strain and teacher creativity was significant but marginal. We concluded that LMX functions as a lens through which teachers perceive their entire work experience, primarily influencing creativity through the path of work resources. In essence, our findings reveal that LMX boost teacher creativity by strengthening collegial trust and engagement, offering practical insights for educational innovation and change.

Keywords Creativity · LMX · Psychological strain · Stress · Trust · Work engagement

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1 Introduction

Increased uncertainty, unpredictability, and instability resulting from global developments, particularly over the past several years, have put schools in dire need of adopting adaptive, visionary, and creative approaches to addressing educational issues (Anderson et al., 2021; Bellibaş et al., 2024). These developments are driven by several factors, including the integration of technology in classrooms, the need to accommodate a diverse student population, and the requirement to support students affected by war, crisis, and conflict (Da'as, 2022; Schachner et al., 2019). Success in addressing these challenges effectively entails educators devising new and novel ideas and solutions, which is important for teacher capacity development and school improvement (Da'as, 2023). However, research on educators' creativity, especially teachers, has been extremely scarce (Adams et al., 2025; Han & Abdrahim, 2023; Ugwuanyi et al., 2025).

Historically, research on individual creativity has been primarily associated with business and organizational studies (Beghetto, 2019; Klijn & Tomic, 2010). However, its relevance to school effectiveness has recently gained global attention (Adams et al., 2025; Ugwuanyi et al., 2025; Da'as, 2023). Several developments highlight this shift in focus: the inclusion of creativity as critical attributes in defining 21st Century Skills (Van Laar et al., 2019); the Organisation for Economic Co-operation and Development (OECD) highlighting creativity and creative thinking as essential skills for learners of the 2030s (OECD, 2018); and the Programme for International Student Assessment (PISA)'s introduction of a test in 2021 to evaluate young people's creative thinking. However, despite the growing emphasis on the creativity of children in schools (Da'as, 2023), relatively little research has been devoted to the development and outcomes of teacher creativity (Adams et al., 2025; Ugwuanyi et al., 2025).

Creativity is a complex and iterative process that requires a strategic and concerted effort to develop and sustain (Hasse et al., 2023). It is a cognitive process of generating original ideas; hence, it can readily be diminished and hindered by various factors that damage mental health (Koeske & Koeske, 1993) and work engagement (Demerouti & Cropanzano, 2010). While pernicious organizational conditions can reinforce ritualized work behaviors and reduce the willingness to engage in creative action (Zhang et al., 2021), conducive workplace factors are necessary to foster a mental state of confidence, optimism, and meaningfulness, which helps teachers stimulate creative ideas and behaviors (Shuck et al., 2017). Educational leaders responsible for developing conducive school processes, structures, and conditions to ensure improved learning appear to be crucial in this process. Recent research has shown that through their individualized consideration and inspirational motivation, school leadership can foster trust, mutual respect, and personal connections with each teacher, ultimately promoting the implementation of creative ideas in classrooms (Bellibaş et al., 2024). Therefore, establishing positive relationships with teachers (LMX) may pave the way for producing adequate job resources, such as trust and engagement, and reduce the strain derived from increased pressure and stress, which together may establish the necessary conditions for teacher creativity (Mascareño, 2020; Tummers & Bakker, 2021). However, our current knowledge base regarding how LMX might play a role in this process has been based predominantly on Western cultures, despite the find-

ings that it is likely to vary across countries and societies (Rockstuhl et al., 2012). The existing assumptions regarding the relationship between LMX and various organizational elements require validation through empirical research conducted in non-Western societies. This is particularly relevant in the context of Kyrgyzstan, where the legacy of Soviet-influenced practices has traditionally not encouraged innovative educational practices (Mussagulova, 2021; Tajik & Makoelle, 2024). The existing traditional relationship between employees and leaders tends to emphasize authoritative leadership styles rather than collaborative and supportive ones.

This study investigates the relationship between LMX and creative teacher behavior within the educational system of Kyrgyzstan, a country with a history of authoritarian leadership styles and a limited body of research on educational leadership. Specifically, drawing on the extended Job Demands–Resources (JD-R) framework proposed by Tummers and Bakker (2021; Fig 1), we examined how LMX may be linked to enhanced teacher creativity through teacher trust and work engagement on the one hand, and workplace stress and psychological strain on the other (Martin et al., 2016). In addition, we investigated how and to what extent LMX might be related to the JD-R mechanisms, to mitigate the negative associations and strengthen the positive relationships between job demands and resources and teachers' engagement, psychological strain, and ultimately, their creative work behaviors.

The following sections discuss the study context, followed by concepts, and introduce each hypothesis linked to the JD-R framework.

1.1 Study context

The data for this study were collected in the Kyrgyz Republic. Having previously been influenced by the Soviet management system, the educational system in Kyrgyzstan is hierarchical and centralized, with the Ministry of Education and Science (MoES) responsible for developing and implementing education policies, as well as regulating and determining educational content, procedures, and initiatives. Within a system of top-down hierarchy, regional authorities at the oblast and district levels are under the supervision of the MoES and deal with budgeting, providing support for organization and management, and assigning school principals.

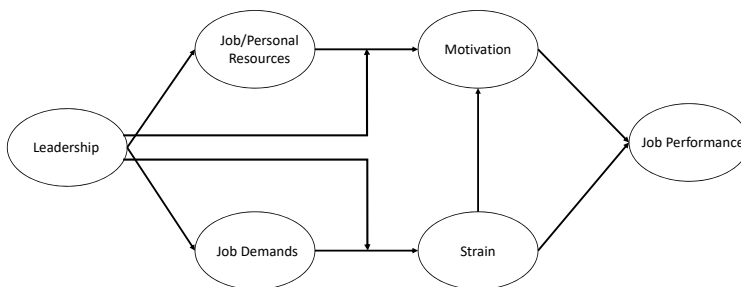


Fig. 1 Leadership within the JD-R framework (adapted from Tummers & Bakker, 2021)

The MoES has adjusted its policy to implement a more student-centered learning approach (Sindhvad et al., 2020) through significant reforms, with the support of international donor organizations. The introduction of new curricula, the development of new schoolbooks, the establishment of independent educational assessments, and, more recently, the usage of digital tools in teaching and learning have been key reform initiatives (Siarova & van der Graaf, 2021). However, despite the reform efforts, the centralized school governance approach of the former Soviet Union continues to dominate the education system, which poses substantial challenges for implementing novel ideas at the school level (Sindvahad et al., 2020).

Concerning school leadership, there has been a notable lack of concrete policies implemented to enhance effective school leadership in the country (UNESCO, 2019). Despite the increase in school leaders' autonomy in recent years, they lack sufficient training on educational administration and leadership to support such increased autonomy (Chapman et al., 2005). Moreover, how school leadership contributes to the development of effective school processes, structures and a positive workplace in this region has not been fully understood. More specifically, empirical research on the role of Kyrgyz school leadership is sparse (Sindhvad et al., 2020). Existing research on the country relied heavily on small sample sizes, limiting these studies from drawing generalizable conclusions regarding the impact of school leadership across the entire Kyrgyz Republic.

2 Theoretical framework

For the present study, we used the JD-R model (Bakker et al., 2023; Demerouti & Bakker, 2023; Mazzetti et al., 2023; Radic et al., 2020; Tummers & Bakker, 2021) to explain mechanisms by which LMX might influence teacher creativity. The JD-R model offers a substantial theoretical ground for understanding the mechanisms underlying job demands and resources that influence work engagement, stress and strain (Tummers & Bakker, 2021). However, the ultimate purpose of the model is to enhance employee performance (see Bakker et al., 2023; Tummers & Bakker, 2021). It investigates the interaction of multiple demand and resource factors to understand key elements of the work and personal aspects that enhance or limit employees' work performance, such as creativity (Du et al., 2019; Olsen et al., 2025).

In the JD-R model, job demands refer to various psychological, social, physical, and organizational aspects of any job that require continuous physical or mental effort, leading to specific physiological and/or psychological (emotional or cognitive) costs (Bakker et al., 2023; Bakker & De Vries, 2021; Demerouti & Bakker, 2023). Some examples might include a high workload, conflicting demands, bullying (Tummers & Bakker, 2021) and an unpleasant physical environment (Demerouti & Bakker, 2011). Contrasted with job demands, job resources also encompass physical, social, psychological, or organizational aspects of a job yet those that (1) support achieving work goals; (2) reduce job demands and related physiological and psychological costs; or (3) promote personal growth and development (Demerouti & Bakker, 2023; Mazzetti et al., 2023; Radic et al., 2020; Tummers & Bakker, 2021). Those aspects could be organizational (a lack of hierarchy), social (e.g., coworker trust), developmental (e.g.,

career perspective), and job-related (participation in decision-making) (Mazzetti et al., 2023). A main difference between the two is that while job demands consume energy, job resources provide motivation (Demerouti & Bakker, 2023). However, challenging job demands can enhance the impact of job resources on organizational outcomes while strong job resources can reduce the negative impact of job demands (Demerouti & Bakker, 2023). In addition, Bakker et al. (2023) emphasized that while some job demands and resources, such as workload and social support, are common across most professions, others are more occupation-specific; for example, emotional and physical demands are especially critical for nurses and police officers, whereas cognitive demands are more relevant for software developers and scientists.

Both self-determination and social exchange theories support the link between LMX and organizational outcomes (Andersen et al., 2020; Gottfredson et al., 2020; Martin et al., 2016; Rockstuhl et al., 2012). Self-determination theory offers a key framework for understanding human motivation, encompassing both intrinsic and extrinsic forms of motivation. People get motivated by both internal factors, such as curiosity and interests, and external factors, including rewards and evaluation. Organizational conditions that promote an employee's positive experience with the job, including autonomy and relatedness, could support enhanced motivation and engagement in job-related activities, such as improved performance and creativity (Martin et al., 2016). Consistent with this theory's assumptions, LMX can create the organizational conditions that stimulate employees' intrinsic motivation, commitment, resilience, engagement, performance, and creativity, while also reducing role ambiguity and turnover intention (Andersen et al., 2020). Similarly, social exchange theory, one of the most influential theories in social sciences (Ahmad, 2023), is often used to examine the impact of high LMX (Rockstuhl et al., 2012). According to Blau (1964), social exchange theory refers to the voluntary action of one individual in response to others, with the expectation of receiving benefits in return. One key aspect of exchange is the development of a relationship, where ongoing mutual exchanges gradually lead to a sense of personal connection (Ahmad et al., 2023). In this view, the relationship itself emerges from interdependent interactions between individuals. For example, as leaders initiate social exchanges through favorable treatment for certain members (Graen & Uhl-Bien, 1995), members, in turn, are expected to reciprocate with favorable treatment. Similarly, one could expect that employees' work-related attitudes and performance would depend on the quality of the relationship between the leader and the employee (Rockstuhl et al., 2012).

The present study is based on the JD-R model, initially introduced by Bakker et al. (2004), and aligns with the enhanced model developed by Tummars and Bakker (2021). The job resources and demands variables are selected strategically, considering the concepts presented in past theoretical JD-R works (see Bakker et al., 2023; Demerouti & Bakker, 2023; Mazzetti et al., 2023; Radic et al., 2020; Tummars & Bakker, 2021) and recent developments in education and current issues in schools that were highlighted in the introduction (see Da'as, 2022; Mascareño, 2020; Tummars & Bakker, 2021; Schachner et al., 2019). In addition, because the majority of demand and resource factors within an organization are malleable to leadership practices and behaviors, recent studies have identified leadership as the primary predictor of JD-R variables (Tummars & Bakker, 2021). Therefore, a recent comprehensive

JDR framework suggests that leadership can indirectly impact employees' job performance (e.g., creativity and productivity) through their direct influence on job demands, job resources and personal resources (Tummers & Bakker, 2021).

Against this background, our model, presented in Fig 2, proposes that stress is a job demand factor that may be related to psychological strain and, therefore, negatively associated with work engagement and teacher creativity as a performance indicator. Whereas horizontal trust (e.g., trust in colleagues) as a job resource will positively influence teacher creativity performance through its positive effect on motivational indicators, such as increased work engagement (Chughtai & Buckley, 2008; Lau & Liden, 2008). Additionally, LMX, the quality of the relationship between the leader and a member (Andersen et al., 2020; Gottfredson et al., 2020), can be classified as either a job source when referring to positive leadership types such as transformational leadership or a demand factor in case of a negative leadership model (Tummers & Bakker, 2021). Consequently, we propose that high LXM will foster teacher trust in their colleagues and work engagement while also helping reduce stress and psychological strain, all of which will stimulate increased teacher creativity (see Fig 2).

The following sections define each concept presented in the theoretical model, as illustrated in Fig 2, and introduce each hypothesis along with its corresponding theoretical foundations.

2.1 Leader-member exchange (LMX)

Despite extensive research on LMX in business administration over the past several decades (Graen & Uhl-Bien, 1995), the integration of this concept in educational research has been relatively new (e.g., Berkovich & Eyal, 2021; Flores et al., 2020; Huang & Yin, 2024). Although there is no clear definition (Gottfredson et al., 2020), LMX is often used to refer to the quality of the relationship between a leader and an employee (Liden & Maslyn, 1998). The initial conceptualization of LMX is based on dyadic interaction (Erdogan & Bauer, 2014). However, LMX has evolved from its original focus on the exchange processes between leader and follower, primarily centered on the dyadic relationship, toward a greater emphasis on how followers perceive the quality of their relationship with the leader (Gottfredson et al., 2020).

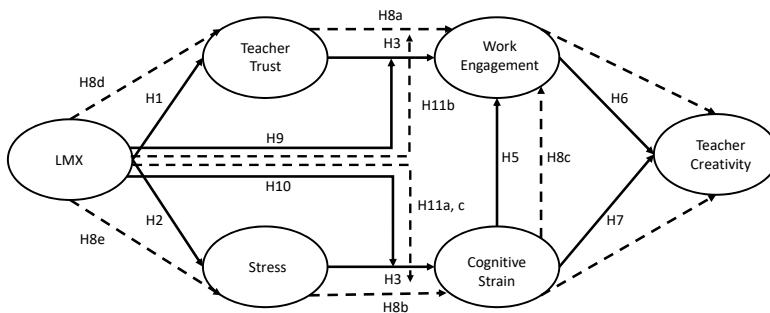


Fig. 2 Relationship between LMX and Teacher Creativity in JD-R Theory

In the present research, this perspective is applied to the school context where LMX refers to the quality of the relationship between the school principal and the teacher (see Flores et al., 2020; Huang & Yin, 2024).

Scholars have indicated that the quality of the relationship between the leader and the individual follower develops over time (Erdogan & Bauer, 2014) and varies with different partners (Andersen et al., 2020). For example, the relationship between the school principal and each teacher would differ. With some, the connection involves deep personal engagement, mutual trust, and a long-term commitment. With others, the relationship may be more limited, characterized by lower levels of trust and primarily based on formal, transactional exchanges (Andersen et al., 2020). This is partly related to the quality of communication between the leader and follower, which can shape (e.g., energize) followers and, in turn, generate a high-quality LMX (Berkovich & Eyal, 2021). High LMX supports followers' commitment to extra-role behaviors (Ng, 2017) in exchange for a positive relationship based on trust, respect, attention, and support (Erdogan & Liden, 2002); whereas, low LMX of a member fosters transactional exchange and demotivates him or her to act beyond formal requirements (Andersen et al., 2020).

2.2 Teacher creativity

Creativity, an indispensable competence for human beings to survive, grow, and excel, has been defined as a mental process to produce original and appropriate or useful ideas that are different from the existing ones (Klijn & Tomic, 2010) or is linked to generating novel and useful solutions to problems (Zhou & George, 2003). These definitions highlight two fundamental aspects of creativity in the workplace: First, for someone to be identified as creative, they should come up with ideas that are both original and useful, implying that original but useless ideas may not be considered creative (Zhou & George, 2003). Second, creativity can be associated with the development of new and effective strategies to solve problems for which no prior solutions exist (Torrance, 1977). It requires thinking outside the box in the face of a challenging situation (Beghetto, 2019). Creativity is contrasted with conformity, which refers to adhering to established routines, practices, or ideas without disturbing others or causing trouble (Torrance, 1977).

For teachers, creativity means “combining and integrating different educational theories, stances, and models about teaching, learning, and instruction in novel ways to address the needs of unique learners” (Bramwell et al., 2011, p. 228). Creative teachers offer original strategies to increase the quality of tasks and to achieve goals and objectives; seek out novel ideas and practices during teaching and learning activities; are open to risktaking when trying new teaching strategies (Da’as, 2023); and tend to come up with novel ideas about education and solutions to classroom problems (Adams et al., 2025). These teachers think imaginatively, take risks, reflect on their practice, and remain open to new approaches. They also approach the performative aspects of teaching with confidence and possess a genuine curiosity to engage with students' ideas and interests (Anderson et al., 2022).

2.3 (Horizontal) Teacher trust

Mayer et al. (1995) define trust as “the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party” (p. 712). What is common in all definitions is the term “vulnerability”. For example, according to Goddard et al. (2001), it is the willingness of someone to take risks in light of vulnerability (Mayer, 1995). Influenced by the works of McKnight et al. (1998) and Mayer et al. (1995), Cunningham and MacGregor (2000) identified three essential dimensions: benevolence, fairness, and predictability. Predictability is related to leaders’ commitment to specific actions. Followers will develop trust if the leader accomplishes what s/he is committed to (Smith, 2005). Benevolence suggests that having predictable behavior is not a sufficient condition for trust to develop; it is also necessary that those behaviors be based on goodwill (Cunningham & MacGregor, 2000). Fairness in the case of trust is the subjective judgment of employees regarding the extent to which situations, treatments, or outcomes are fair (Streicher et al., 2014). A review of research on organizational trust reported its association with a wide range of individual and organizational factors, including burnout, turnover, commitment, job satisfaction, readiness to change, physical and psychological health, work engagement, performance, motivation, organizational identification, and innovation (Rahayuningsih, 2019).

Consistent with the general definitions, in education, teacher trust refers to “a teacher’s willingness to be vulnerable to another party based on the confidence that the latter is benevolent, reliable, competent, honest, and open” (Hoy & Tschannen-Moran, 1999, p. 189). While researchers traditionally focus on leader-follower (or vertical) trust relationships (Chughtai & Buckley, 2008), in the present research we refer to horizontal trust, which implies a trusting relationship between coworkers (teachers in the current study). Unlike the relationships between leaders and other members of an organization, relationships between coworkers (e.g., teachers) involve a relatively less pronounced imbalance of authority. Here, vertical supervisor-follower and employee-manager relationships are unlikely to develop (Tan & Lim, 2009).

Researchers have reported that trusting relationships among teachers require strong leadership, and they can contribute significantly to improved performance and outcomes. For example, within a positive relationship that principals develop with each teacher, teachers will feel obligated to behave in a trustworthy manner (Bowler et al., 2018). Similarly, Moos (2015) suggested that the creative and innovative work performance requires support from leadership and collective action among teachers, which is less likely to happen unless teachers trust each other. Focusing on schools in poverty in the USA, Bryk and Schneider (2002) pointed out that schools that demonstrated improvement differed from non-improved schools based on their differences in the level of trusting relationships among teachers (teacher-to-teacher trust) since this encourages teachers to refrain from closed doors and the repetition of the same teaching practices over time. In addition, schools with high-trust relationships tend to have higher levels of teacher commitment, stronger ties with parents, better student welfare, as well as a stronger orientation toward innovation, showing a willingness to

take risks and develop and try new ideas (Bryk & Schneider, 1996). Supporting these claims, Schwabsky et al. (2020) found a positive relationship between trust-based relationships among teachers and the implementation of creative ideas.

2.4 Work engagement

Work engagement is defined as an individual's positive connection with their work, wherein they voluntarily contribute physical, cognitive, and emotional resources to work-related activities (Klassen et al., 2012; Perera et al., 2018; Schaufeli et al., 2002). Kahn (1990) laid the groundwork for understanding work engagement, highlighting the psychological immersion, attentiveness, integration, and focus that engaged workers bring to their roles. Building upon this, Schaufeli et al. (2002) expanded the scope of this concept by defining 'engagement at work' as a positive, job-related, affective-cognitive state of mind characterized by vigor, dedication, and absorption. Vigor is represented by the availability of high energy and mental resilience at work associated with a willingness to put in effort and persistence despite challenges. Dedication is about being actively engaged in one's work, and having a sense of importance, enthusiasm, inspiration, pride, and challenge. Finally, absorption can be observed when employees are fully focused and happily immersed in their work, where time seems to fly and it's hard to disengage. Engaged employees are characterized by their pursuit of goals, flexibility in thinking, and the significant effort they invest in their work (Eldor & Harpaz, 2016; Koch et al., 2015). This behavior encompasses adapting to changes, adopting a proactive stance, and sharing knowledge and feedback (Janssen, 2000; Eldor, 2017; Maden, 2015). In the realm of education, the concept entails that teachers intentionally allocate significant intellectual effort to their teaching tasks. They foster positive attitudes toward their work, encompassing feelings of satisfaction and well-being. Additionally, they actively work to build positive relationships with both students and colleagues. Collectively, these elements can enhance overall teacher effectiveness (Bakker et al., 2007; Klassen et al., 2012).

2.5 Workplace stress

Broadly conceptualizing, stress can be defined as a general set of physiological and psychological reactions of the body that occur in response to any demand for change (Selye, 1956). In the present paper, we followed the definition by Petrowski et al. (2012), who define stress as the frequency of the continual occurrence of various stressors with unmanageable consequences over a relatively extended period, or the absence of effective coping strategies. A wide range of factors, including workload, physical conditions, time pressure (Demerouti et al., 2001), work discontent, high work demands, the absence of social recognition, and social isolation and tension, could lead to stress (Schulz et al., 2004 as cited in Petrowski et al., 2012), characterized by interruption of the balance of the emotional, environmental and cognitive system (Demerouti et al., 2001). In a specific workplace, multiple roles and responsibilities, including obligations, interpersonal relationships, and activities, can lead to members of an organization experiencing chronic stress (Farley et al., 2021). From the JD-R perspective, the combination of high job demands and low

job resources creates a high-stress work environment that is likely to lead to strain and burnout (Bakker & De Vries, 2021). Among the multifaceted consequences are low job satisfaction, poor performance, high absenteeism, high turnover rates, and strained relationships (Hansen & Sullivan, 2003), as well as burnout, exhaustion, and depleted energy (Demerouti et al., 2001).

In educational organizations, teacher stress is conceptualized as “the experience by a teacher of unpleasant, negative emotions, such as anger, anxiety, tension, frustration, or depression, resulting from some aspect of their work as a teacher” (Kyriacou, 2001, p. 28). Dealing with high workloads, particularly under time pressure (Ilies et al., 2015), significantly exacerbates teachers’ stress (Farley et al., 2021; Yedawani, 2021). Other factors might include longer working hours, and low salaries (Farley et al., 2021). High workplace stress can have pernicious consequences for teachers’ overall wellbeing, as well as their commitment to the profession and the school and can lead to health problems, depression, and burnout (Hansen & Sullivan, 2003).

2.6 Psychological strain

The tense labor market and rapidly evolving demands have led to intensified work worldwide, requiring employees to work under time pressure and in social interaction, which ultimately increases mental strain (Mohr et al., 2006). Strain implies the depletion of emotional and physiological resources (Koeske & Koeske, 1993). It refers to negative affective responses by employees, characterized by a strong sense of loss and lack of energy (Tan & Vanderberghe, 2021). Psychological strain might arise when an employee is constantly exposed to intensified work demands (James & Sidin, 2017). It is therefore defined as a psychological outcome that emerges in response to high organizational demands (Jdaitawi et al., 2014) or as a psychological reaction to a poor working environment (Kao & Kuo, 2020). Job strain increases when employees lack consistent organizational support and possess limited personal coping resources. When employees are repeatedly exposed to the full cycle of strain, a gradual buildup ensues that eventually becomes unmanageable and leads to burnout (Bakker & De Vries, 2021).

Researchers often use two psychological strain variables—anxiety and emotional exhaustion (Boswell et al., 2004). Anxiety is a type of psychological distress and refers to a person’s emotional reaction to stressful situations (Jex & Beehr, 1991), while emotional exhaustion reflects a lack of energy, drained emotional resources (Cordes & Dougherty, 1993), irritability, and demoralization (Wettstein et al., 2023). When it comes to schools, little is known about teacher psychological strain due to the scarcity of research. The term is highly relevant to the teaching profession due to various challenges, including long working hours, administrative burdens, classroom management issues, and a lack of autonomy (McCarthy, 2019). Accordingly, they were reported to experience higher workplace stress and burnout than people in other professions (Wettstein et al., 2023). Therefore, the inevitable consequences of psychological strain, including depression, anxiety, anger, depression, hostility, lower self-confidence, irrationality, irritability, as well as poor job performance because of absenteeism, and fatigue (James & Sidin, 2017), could also be relevant to the teaching profession.

3 Research hypotheses

Against this background and following the extended JD-R model proposed by Tummers and Bakker (2021), we present several hypotheses regarding the (indirect) influence of LMX on teachers' creativity within a JD-R framework.

According to the JD-R theory, leadership acts as a key job resource that enhances employees' personal and interpersonal capacities (Tummers & Bakker, 2021). High-quality relationships between the leader and follower, characterized by mutual trust, respect, and support, can serve as a relational resource that fosters psychological safety and a sense of belonging. When teachers perceive their principals as considerate, responsive, and appreciative, they are more likely to reciprocate with trust in the leader, the organization, and other employees (Tschannen-Moran & Gareis, 2015). Positive leadership behavior enhances social support and reduces ambiguity and strain, thereby reinforcing trust among colleagues and promoting a more cohesive, collaborative school environment (Tummers & Bakker, 2021). Thus, strong LMX relationships serve as fertile ground for the development and maintenance of teacher trust. Scholars have asserted that leadership can play an essential role as "trust information transmitters," influencing the development of trust among coworkers (Lau & Liden, 2008). Particularly, defined as the quality of a dyadic relationship between leaders and organization members (Erdogan & Liden, 2002), LMX may provide a strong foundation for trust-based exchange among co-workers (Lau & Liden, 2008). Referring to the balance theory (Heider, 1958), Lau & Liden, (2008) argue that for balance to be maintained, co-workers will trust each other in return for the leader's trust in them. Within a positive dyadic relationship, employees who engage in a trust-based relationship with the leader will feel obligated to behave in a trustworthy manner (Bowler et al., 2018) because first employees will feel a sense of responsibility to uphold their leaders' trust by acting reliably (Pietsch et al., 2025; Witthöft et al., 2025) and second they will want to perform well and become more capable in coworkers' eye in exchange for leaders support for the trusted employees (Lau & Liden, 2008).

H1 *LMX is positively related to horizontal teacher trust.*

The way the leader treats members will influence the quality of their relationships with coworkers as well as many other aspects of the work (Harms et al., 2017). Within the recent comprehensive JD-R theory, offered by Tummers & Bakker (2021), leadership can play a key role in enhancing job resources and reducing job demands. Leadership functions as a critical job resource that can buffer the impact of job demands on employee stress (Tummers & Bakker, 2021). When leaders form strong, trust-based relationships with employees, they provide emotional support, clarity, and assistance, which help individuals cope with stressors such as workload or conflicting expectations. As LMX may vary among different employees, the employee's sense of inequality in the relationship with the leader can impact their overall wellbeing and work stress (Liang et al., 2022). LMX supports access to valuable work-related resources from the leader, such as social support, which bears considerable potential to prevent the emergence of work stress (Wilson et al., 2010). Many stress-related factors such as work discontent, high work demands, the absence of social recogni-

tion, and social isolation (Schulz et al., 2004) could be alleviated through a high-quality dyadic relationship (Liang et al., 2022) based on trust, attention, and more importantly support (Erdogan & Liden, 2002). A good relationship with the leader can reduce stress levels by creating the necessary organizational conditions that stimulate employees' intrinsic motivation, commitment, and resilience and reduce role ambiguity (Andersen et al., 2020).

H2 *LMX is negatively related to workplace stress.*

While there is a relatively established conclusion regarding vertical trust and employees' work engagement (e.g., Engelbrecht et al., 2017), the relationship between horizontal trust and work engagement is unknown due to limited research (Chughtai & Buckley, 2008). However, consistent with the research on vertical trust, researchers proposed a positive association between horizontal trust and employee engagement (Chughtai & Buckley, 2008). This is primarily based on the JD-R theory claims. This theory suggests that job resources, including physical, social, psychological, or organizational elements of a work, can support employees in achieving work goals and enhancing their work performance, including engagement and creativity (Demerouti & Bakker, 2023; Mazzetti et al., 2023; Radic et al., 2020; Tummers & Bakker, 2021). Lua and Liden (2008) claimed that when employees have a sense of trust in their coworkers' performance, they are more motivated to put in extra effort, knowing their hard work will be recognized and rewarded. Furthermore, when employees are confident in their coworkers' abilities, proficiency, and knowledge within the organization, this increases their work motivation and can result in greater work engagement (Chughtai & Buckley, 2008). Tschannen-Moran and Gareis (2015) indicated that, for school leaders to be trusted, they need to demonstrate authentic concern for teachers' well-being. This kind of caring, known as benevolence, reflects a sincere intention to act in others' best interests and a readiness to offer support when needed. These principals also involve teachers in decision-making processes, which in turn helps them feel respected, included, and valued within the school community. They also highlighted that this trusting relationship is likely to reinforce shared norms of professionalism, academic seriousness, and strengthen teachers' emotional and professional investment in their work, leading to higher levels of engagement, motivation, and commitment to the school's mission.

H3 *Horizontal teacher trust is positively related to work engagement.*

It was suggested that a certain level of stress arising from challenges might be a positive feeling due to the potential for gain; however, it makes sense to argue that psychological strain can be anticipated if events are experienced as stressful, regardless of their potential for gain (Boswell et al., 2004). Stress, as a state characterized by the continual occurrence of various unpleasant factors over an extended period (Petrowski et al., 2012), is expected to result in strain, particularly when effective coping strategies are lacking (Fogarty et al., 1999). JD-R is the leading theory to support his claim. Bakker and De Vilt (2021) indicated that when employees consistently face intense job demands, they are likely to feel increased strain (Bakker et al., 2023;

Demerouti & Bakker, 2023). Stress in the workplace has been identified as one of the most deleterious job demands (Bakker & De Vries, 2021). Any potential stressor poses a threat to a person, likely causing strain (Cummings & Cooper, 2013). In this regard, psychological strain refers to the adverse reaction an individual experiences in response to a stressor (Beehr & O'Hara, 1987). Consequently, the psychological strain has been regarded as a stress-related outcome (Bakker & De Vries, 2021; Francis & Barling, 2005).

H4 *Workplace stress is positively related to psychological strain.*

Scholars were confident in proposing a negative association between psychological strain and work engagement (Zacher & Winter, 2011; Wang et al., 2023) based on JD-R theory. Strain has been presented as a natural consequence of job demand, such as stress and workload (Demerouti & Bakker, 2023; Trimmer & Bakker, 2021). Psychological strain resulting from stress prevents employees from investing their time and energy in their work (Bakker & De Vries, 2021) because it creates burnout, which is often characterized as opposed to work engagement (Chughtai & Buckley, 2008). Employees who feel physically fatigued and emotionally exhausted due to high organizational demands (Jdaitawi et al., 2014; Kao & Kuo, 2020) and related emotional depletion as a result (Radic et al., 2020) would possess fewer psychological resources to devote to tasks; hence they would feel less energized and dedicated during their workday (Zacher & Winter, 2011). Moreover, it has been asserted that employees who are drained of energy and emotional resources (Cordes & Dougherty, 1993) are less likely to be willing to work diligently (Wang et al., 2023).

H5 *Psychological strain is negatively related to work engagement.*

JD-R suggests that job resources reduce the impact of demands and enhance energy and dedication to their work (Bakker et al., 2023; Demerouti & Bakker, 2023; Mazzetti et al., 2023; Radic et al., 2020). Teacher engagement encompasses cognitive, emotional, and physical dimensions (Klassen et al., 2013), all of which might be critical in promoting the creation and development of new ideas among educators. Engaged employees frequently experience positive emotions, which broaden their cognitive processes and contribute to the development of personal resources. These emotions promote innovative ideas by enhancing curiosity and the motivation to acquire and integrate new knowledge (Truong et al., 2021). In addition, cognitive engagement involves the mental dedication and energy directed towards tasks, emphasizing cognitive flexibility and the effort to diverge from established norms and processes. This form of engagement can be important for generating novel ideas and solutions, and hence fostering creativity (Martinez, 2015). As highlighted by Seligman & Csikszentmihalyi, (2000), generating new ideas requires a departure from existing systems, advocating for alternative approaches. Cognitive engagement can fuel this process by enabling individuals to re-evaluate existing knowledge, broaden their cognitive and perceptual boundaries, and explore unconventional idea combinations (Fredrickson, 2001). Employees' affective connection towards their work, encompassing feelings of confidence, optimism, and a sense of meaningful-

ness in their efforts can also be critical for motivating proactive behavior and sustaining engagement with creative and innovative tasks, primarily by enhancing the perceived value and satisfaction derived from engaging in these processes (Demerouti & Cropanzano, 2010; Shuck et al., 2017).

H6 *Work engagement is positively related to teacher creativity.*

According to the JD-R theory, employee outcomes are shaped by the balance between job demands (e.g., workload, emotional pressure) and job resources (e.g., autonomy, support, feedback) (Bakker et al., 2023; Demerouti & Bakker, 2023). Strain arises when job demands are high and not adequately compensated by resources, leading to other negative consequences related to wellbeing and performance (Bakker & De Vries, 2021; Radic et al., 2020). Factors such as physically demanding tasks, time constraints, and insufficient job resources can lead to psychological strain (Christian et al., 2011). The evidence regarding the relationship between stress, strain, and creativity is mixed. In some cases, employees may consider strain as a challenging aspect of their work, rather than hindering their creativity and performance (Ghafoor & Haar, 2022). However, theoretical works suggested that psychological strain refers to the depletion of emotional and physiological resources (Koeske & Koeske, 1993). It therefore simplifies the thinking capability of individuals; reinforces ritualized work behaviors; leads to reduced motivation for more challenging work, and hence reduces the chance for employees' involvement in creative action (Van Dyne et al., 2002). This limited source requires increased time and energy to address stress, leaving fewer resources available for generating something new and original (Zhang et al., 2021). Consistently, employees' capability to cope with strain can stimulate creative behavior (Ghafoor & Haar, 2022).

H7 *Psychological strain is negatively related to teacher creativity.*

Based on the rationale provided in the first seven direct relationship hypotheses, several other hypotheses that assume indirect relationships can also be proposed.

H8a *Trust is positively related to teacher creativity via work engagement.* **H8b:** *Stress negatively affects teacher creativity via psychological strain.* **H8c:** *Psychological strain is negatively related to teacher creativity via work engagement.* **H8d:** *LMX is positively related to teacher creativity mediated by trust and work engagement.* **H8e:** *LMX is positively related to teacher creativity mediated by psychological strain and stress (and work engagement).*

Developing a trust-based relationship among coworkers can stimulate employees' desire for increased work performance, as trust provides a positive sense regarding other employees' capabilities and knowledge, which in turn increases work motivation and leads to greater work engagement (Chughtai & Buckley, 2008). LMX could provide additional support to this relationship by strengthening it. LMX is based on high-quality social exchange and employees with high-quality relationships experience more resources, respect, and support from their leaders (Erdogan &

Liden, 2002). High LMX employees could be more willing to work with their trusted coworkers, which would increase their work engagement (Andersen et al., 2020). When the leader is supportive and appreciative, leadership acts as a job resource (Tummers & Bakker, 2021) that enhances the positive effects of job resources on motivation, engagement and performance (Demerouti & Bakker, 2023). In contrast, when LMX is low, even strong peer trust may not fully translate into high engagement due to a lack of leadership support (Tummers & Bakker, 2021). This is because low LMX may reduce employees' motivation to spend extra effort regardless of their level of trust in other employees as those employees may not receive enough emotional and resource support from their leader, get a sense that their extra-role behaviors will not be recognized, and ultimately become less engaged with their work (Liden & Graen, 1998).

H9 *LMX moderates the relationship between horizontal trust and work engagement.*

Psychological strain is a natural consequence of workplace stress (Beehr & O'Hara, 1987; Francis & Barling, 2005). Strain is a reaction to high organizational demands (Jdaitawi et al., 2014) and a poor working environment (Kao & Kuo, 2020), which are also sources of stress (Hansen & Sullivan, 2003). However, stress may not always lead to strain if the employee develops effective coping strategies or has sufficient coping resources (Demerouti et al., 2001). A high LMX could play a coping mechanism that precludes stress factors from resulting in psychological strain. Employees with high LMX are loyal and trusted members and therefore receive increased support from their leader, as the leader is aware of the followers' needs and challenges and provides support to solve problems (Graen & Uhl-Bien, 1995). Those employees experience a lower sense of overload and associated psychological strain (Tan & Vanderberghe, 2021). Good relationships are established when leaders are considerate and support employees by asking how they are, responding to their requests for help, and complimenting them when they do a good job (Tummers & Bakker, 2021). This relationship could help employees to feel less strain, even in the case of a highly stressful work environment. As indicated by JD-R theory, strong leadership is a substantial job resource in any organization (Tummers & Bakker, 2021). The strength of a job resource can mitigate the negative impact of job demands on employee performance and well-being (Demerouti & Bakker, 2023). Consequently, high LMX can be an adequate job resource that helps employees feel less strain in the face of stressors, while those with lower LMX are more likely to suffer strain when facing stressors (Wei et al., 2021).

H10 *LMX moderates the relationship between workplace stress and psychological strain.*

Considering the moderating role of LMX in the relationship between trust and work engagement (H9) and between stress and psychological strain (H10) along with the indirect relationships proposed in H8a, H8b, and H8c, an additional three moderated mediation hypotheses could be proposed.

H11a *LMX is reduce the negative relationship between stress and teacher creativity via psychological strain. H11b: LMX increases the positive relationships between horizontal trust and teacher creativity through the mediating role of work engagement. H11c: LMX decreases the relationship between workplace stress and teacher creativity through the mediating roles of psychological strain and work engagement.*

4 Methods

The present study relies on a cross-sectional survey design and latent-moderated and mediated structural equation modeling to test the proposed hypothesis. The following sections begin with a description of the context and sample, followed by the elaboration of data collection tools and procedures, and data analysis strategies.

4.1 Sample and data collection

A stratified cluster sampling procedure was employed to collect data from both public and private schools at all three levels (primary, lower secondary, and secondary) across all seven regions (oblasts) of Kyrgyzstan, along with the two independent cities of Bishkek and Osh. The first step was to divide all schools ($N = 2,310$) in Kyrgyzstan's Educational Management and Information System (EMIS) into subgroups by geographic location (village or city) and seven regions. Following the OECD's sampling strategy (OECD, 2018), a random sampling procedure was used to select 150 schools from these subgroups. The school sample, which is representative of the Kyrgyz regions, is composed as follows (in each case: total number of schools drawn (urban/rural): Batken: 16 (3/13); Bishkek City: 12 (12/0); Chui: 22 (1/21) Jalal-Abad: 31 (4/27); Issyk-Kul: 12 (2/10); Naryn: 9 (1/8); Osh City: 5 (5/0); Osh Oblast 36 (0/36); Talas: 7 (1/6).

Next, all schools in the sample received an official invitation letter from MoES, and 147 (98%) agreed to participate in our study. Finally, all teachers in volunteer schools were invited to take part in the survey, which was conducted as an anonymous online study using Google Forms. A total of 5,052 teachers (response rate: 90%) completed the survey forms. The data collection duration was from October 2022 to January 2023, with the support of local coordinators from each of the seven regions and two cities.

4.2 Measures

Leader Member Exchange (LMX, $\omega = 0.755$). We adapted Graen and Uhl-Bien's (1995) seven-item scale to assess the quality of the principal-teacher relationship in Kyrgyz schools. Teachers responded to all seven items on a five-point Likert-type scale. An example item is "How would you characterize your working relationship with your principal?", coded from 1 (None) to 5 (Very high). Another example item is "I have enough confidence in my principal that I would defend and justify his or her decision if he or she were not present to do so.", also coded from 1 (Strongly Disagree) to 5 (Strongly Agree).

Teacher Trust (TTR, $\omega = 0.881$). To capture a teacher's trust in their colleagues, referred to as horizontal trust, we followed the conception of Tan and Lim (2009), which is based on the trust model of Mayer et al. (1995). To achieve this objective, we adapted the four-item scale developed by Dederich and Pietsch (2023) to measure co-workers' perceived benevolence, competence, integrity, and honesty. All items were measured on a four-point Likert-type scale, coded from 1 (totally disagree) to 4 (totally agree). An example item is, "I can, by and large, trust that the colleagues at my school always keep their promises."

Work Engagement (ENG, $\omega = 0.914$). We assessed teachers' "positive, fulfilling, work-related state of mind that is characterized by vigor, dedication, and absorption" (Schaufeli et al., 2002, p. 74) with the 3-item ultra-short version of the Utrecht Work Engagement Scale (UWES-3; Schaufeli et al., 2019), with each item indexing one of the three engagement dimensions. All items were measured on a four-point Likert-type scale, coded from 1 (strongly disagree) to 4 (strongly agree). An example item is (i.e., absorption) "I am immersed in my work".

Workplace Stress (WST, $\omega = 0.673$). We measured stress experienced at school on a unidimensional scale (Petrowski et al., 2019) using three previously published items from the Trier Inventory for Chronic Stress (TICS, Petrowski et al., 2012), with items related to the dimensions of work overload, excessive demands at work, and work discontent, respectively. All items were measured on a four-point Likert scale, coded from 1 (strongly disagree) to 4 (strongly agree). An example item is (i.e., work overload; see also: Schlotz et al., 2004): "I have too little time to perform my daily tasks."

Psychological Strain (STR, $\omega = 0.657$). We captured teachers' subjective reactions to unpleasant experiences in the school context using three items from Mohr et al.'s (2006) Irritation Scale: one item assessing cognitive strain and two assessing emotional strain. All items were measured on a four-point Likert scale, coded from 1 (strongly disagree) to 4 (strongly agree). An example item is (i.e., emotional strain): "When I come home tired after work, I feel rather irritable."

Teacher Creativity (TCR; $\omega = 0.836$). To measure teachers' self-reported creativity, we adapted three items from George and Zhou (2001) that assess workplace creativity. All items were answered on a 4-point Likert-type scale (1 = strongly disagree, 4 = strongly agree). An example item is: "I demonstrate creativity at work when given the opportunity."

4.3 Data analyses

In this study, we employ latent-moderated structural equation modeling (LM-SEM; Cheung et al., 2021), using the maximum likelihood estimator with robust (Huber-White) standard errors (MLR) in *Mplus* 8.5 (Muthén & Muthén, 2017). As teachers were nested within schools, we requested cluster-robust standard errors by specifying TYPE = COMPLEX. To estimate random-effect models, the TYPE = RANDOM option was used.

To assess the goodness-of-fit of the models, we employed the standardized root mean square residual (SRMR) and the comparative fit index (CFI), with cut-offs of $SRMR < 0.08$ and $CFI > 0.90$ (Hu & Bentler, 1999). We refrained from using the

root mean square error of approximation (RMSEA), as it is sensitive to the method used to estimate model parameters and performs poorly with ordinal indicators (Shi & Maydeu-Olivares, 2020).

To evaluate the robustness of the mediation, we conducted a bootstrapped mediation analysis, which provides 95% bias-corrected bootstrap confidence intervals with 1,000 bootstrap replications (Hayes, 2018; Preacher & Hayes, 2008). The significance of indirect relationships is determined by the extent to which the 95% confidence intervals (CIs) exclude the value of zero (Hayes, 2018).

In the absence of suitable indices for random effects models, we evaluated the relevance of interactions by comparing the log-likelihoods of the model without and the model with latent interactions, employing a log-likelihood ratio test and reporting coefficient D (Klein & Moosbrugger, 2000). Furthermore, an investigation was conducted to determine whether the newly added parameters could explain additional variance in the dependent variables by examining ΔR^2 (Maslowsky et al., 2015). As our data were collected using a single instrument, we initially investigated the potential for common method bias by loading all items used in the analyses onto a single unrotated factor (Harman, 1960). A value below 50% indicates that a common method bias in model estimates is unlikely (Lance et al., 2010). In our case, the common variance was 28.87%, which is considerably below the 50% threshold.

5 Results

This section begins with descriptive statistics, followed by findings from the main models, including SEM, mediation, and moderation.

5.1 Descriptive statistics and measurement models

Descriptive statistics as shown in Table 1 indicate that the mean value is medium-high for LMX ($M = 3.67$, $SD = 0.76$), high for Work Engagement ($M = 3.54$, $SD = 0.75$), Teacher Trust ($M = 3.30$, $SD = 0.77$), and Teacher Creativity ($M = 3.30$, $SD = 0.75$), and lowest for Stress in the Workplace ($M = 1.96$, $SD = 0.80$). The teachers surveyed further reported a relatively high level of Psychological Strain ($M = 2.41$, $SD = 0.84$).

Table 1 Means, standard deviations, correlations of latent and manifest variables

	M	SD	LMX	TTR	ENG	WST	STR	TCR
LMX	3.67	0.76	1					
TTR	3.30	0.77	0.321	1				
ENG	3.54	0.75	0.191	0.628	1			
WST	1.96	0.80	-0.119	-0.077	0.041	1		
STR	2.41	0.84	-0.147	-0.018	0.110	0.622	1	
TCR	3.30	0.75	0.208	0.587	0.646	0.000	0.056	1

Bold correlations *significance at $p < .05$* ; LMX Leader-Member-Exchange, TTR Teacher Trust (horizontal); ENG Work Engagement; WST Workplace Stress; STR Psychological Strain; TCR Teacher Creativity

The highest correlations are between engagement and creativity ($r = .646, p < .05$), trust and engagement ($r = .628, p < .05$), stress and strain ($r = .622, p < .05$), and trust and creativity ($r = .587, p < .05$), respectively. All high correlations are positive and significant. However, there are also negative and significant correlations: LMX and STR ($r = -.147, p < .05$), LMX and stress ($r = -.119, p < .05$), and trust and stress ($r = -.077, p < .05$).

Before testing the proposed SEM model, we estimated a baseline measurement model including all latent variables. The overall model fit was good (CFI = 0.956, SRMR = 0.057). The measurement models for LMX (CFI = 0.963, SRMR = 0.029) and horizontal teacher trust (CFI = 0.981, SRMR = 0.021) also showed a good fit. For the remaining latent variables, each indicated by only three items, we do not report separate model fit indices, as these models are just-identified and would therefore show a perfect fit by definition.

5.2 Structural equation model

We constructed a structural equation model to examine the interrelationships among LMX, horizontal trust, work engagement, stress, psychological strain, and teacher creativity (H1-H7). This model does not include moderation and uses the MLR estimator. The SEM results indicated a good fit of the proposed model to the data (CFI = 0.950, SRMR = 0.064). The estimation of the standardized regression coefficients yielded the following results (Table 2): LMX \rightarrow Teacher Trust ($\beta = 0.322, p < .001$); LMX \rightarrow Stress ($\beta = -0.137, p < .001$); Teacher Trust \rightarrow Work Engagement ($\beta = 0.642, p < .001$); Stress \rightarrow Strain ($\beta = 0.627, p < .001$); Strain \rightarrow Work Engagement ($\beta = 0.126, p < .001$); Work Engagement \rightarrow Creativity ($\beta = 0.661, p < .001$); Strain \rightarrow Creativity ($\beta = -0.024, p = .098$). These results confirm all hypotheses from H1 to H6. However, H7, which assumes a negative and significant relationship between psychological strain and teacher creativity, is only confirmed at the one-tailed p -value. The model variables account for 43.4%, 1.9%, 39.3%, 42.4%, and 10.4% of the explained variance in teacher creativity, strain, stress, work engagement, and trust, respectively.

5.3 Mediation analysis

To investigate our hypotheses H8a-H8e, and, hence, all indirect effects in the model, we re-estimated the structural equation model but this time by employing a bootstrapping procedure with 1,000 replications and calculated total indirect relationships—that is, the sum of all indirect and partially indirect associations (Preacher & Hayes, 2008). Results are reported in Table 2. The analyses demonstrate a significant total indirect relationship between LMX and creativity ($\beta = 0.132, 95\%CI [0.111, 0.158], p < .001$). This effect is comprised of three distinct partially indirect relationships: one mediated via teacher trust and engagement ($\beta = 0.137, 95\%CI [0.110, 0.165], p < .001$) yet extremely small (and hence showing an according p -value) via stress and strain ($\beta = 0.002, 95\%CI [-0.001, 0.005], p = .108$). Concerning the more complex path from LMX to teacher creativity via stress, strain and engagement, the result is also significant but negative ($\beta = -0.007, 95\%CI [-0.011, -0.004], p < .001$).

Table 2 Estimates for the SEM, mediation, and moderation models

Path/Effect	β	95% CI [LL, UL]	p	Result
Structural Equation Model				
LMX \rightarrow Teacher Trust	0.322	—	< 0.001	Significant
LMX \rightarrow Stress	-0.137	—	< 0.001	Significant
Teacher Trust \rightarrow Work Engagement	0.642	—	< 0.001	Significant
Stress \rightarrow Strain	0.627	—	< 0.001	Significant
Strain \rightarrow Work Engagement	0.126	—	< 0.001	Significant
Work Engagement \rightarrow Creativity	0.661	—	< 0.001	Significant
Strain \rightarrow Creativity	-0.024	—	0.098	n.s.
Mediation Analysis				
LMX \rightarrow Creativity (Total Indirect Effect)	0.132	[0.111, 0.153]	< 0.001	Significant
Teacher Trust \rightarrow Creativity (Total Indirect Effect)	0.424	[0.387, 0.461]	< 0.001	Significant
Stress \rightarrow Creativity (Total Indirect Effect)	0.037	[0.016, 0.059]	0.010 (one-tailed)	Significant
Cognitive Strain \rightarrow Creativity (Total Indirect Effect)	0.059	[0.026, 0.093]	< 0.001	Significant
LMX \rightarrow Work Engagement (Total Indirect Effect)	0.196	[0.168, 0.225]	< 0.001	Significant
Stress \rightarrow Work Engagement (Total Indirect Effect)	0.079	[0.059, 0.099]	0.098	Significant
LMX \rightarrow Cognitive Strain (Total Indirect Effect)	-0.086	[-0.122, -0.059]	< 0.001	Significant
Moderation Analysis				
LMX \times Workplace Stress \rightarrow Psychological Strain	0.009	—	> 0.10	n.s.
LMX \times Horizontal Trust \rightarrow Work Engagement	-0.012	—	> 0.10	n.s.

LMX Leader–Member Exchange; β standardized coefficient; CI confidence interval; LL lower limit; UL upper limit; n.s. non-significant

The analysis further indicated that the total indirect association between teacher trust and creativity, mediated by teacher engagement, is positive and significant ($\beta=0.424$, 95% CI [0.387, 0.461], $p < .001$). The total indirect relationship between stress and creativity is small and only significant at a one-tailed test ($\beta=0.037$, 95%CI [0.016, 0.059], $p < .010$). This is, because the total indirect association between stress and teacher creativity, mediated by strain and engagement, is unexpectedly positive and significant ($\beta=0.052$, 95% CI [0.034, 0.070], $p < .001$) and the effect on creativity via stress and strain is small and not significant ($\beta=-0.015$, 95% CI [-0.033, 0.003], $p > .10$). Moreover, the total indirect relationship between strain and creativity is significant and positive ($\beta=0.059$, 95% CI [0.026, 0.093], $p < .001$). Consequently, the mediation analyses confirm our hypotheses H8a, H8b, H8d and H8e. In contrast, Hypothesis H8d is rejected because a positive relationship is identified between psychological strain and teacher creativity, which is mediated by work engagement.

5.4 Moderation analysis

To test the moderation role of LMX, we included two latent interaction terms using the XWITH statement and re-estimated the model as a complex random effects model. To receive standardized path coefficients, we first standardized all manifest indicator variables, following Maslowsky et al. (2015). The first interaction (H9) suggests that LMX may mitigate the relationship between workplace stress and psychological strain. The second interaction (H10) suggests that LMX may amplify the relationship between horizontal trust and teacher work engagement. The analyses show that both added coefficients were not statistically significant (Table 2): LMX*Workplace Stress \rightarrow Psychological Strain ($\beta = 0.009, p > .10$); LMX*Horizontal Trust \rightarrow Work Engagement ($\beta = -0.012, p > .10$). This means a rejection of two hypothesis, along with other hypotheses that propose moderated mediation (H11a-H11c). Accordingly, ΔR^2 amounted to 0.003 for work engagement and 0.004 for psychological strain. Nevertheless, the combined moderating effect of coefficient D for all investigated moderation effects (H9, H10, H11a-c) is 13.795 ($df = 1, p < .001$), indicating that LMX remains a relevant moderator when considering the complexity of the overall model as a whole.

6 Discussion

Although creativity has recently been emphasized as an indispensable component for teachers who must deal with the multifaceted issues facing education, schools, and students, research on how to promote creative teacher behavior in the workplace has been scarce (Da'as, 2023; Han & Abdrahim, 2023). In line with previous research using the JD-R framework and the suggested link between leadership and employee performance (Bakker et al., 2004; Tummers & Bakker, 2021), this study examined the relationship between LMX and teacher creativity. It utilized teacher horizontal trust as a job resource element that could be associated with teacher creativity through engagement and workplace stress, serving as a demand factor that could be negatively related to teacher creativity through its negative link to engagement and positive association with psychological strain. Using a large dataset collected in Kyrgyzstan, we conducted a moderated mediation analysis to understand the mechanisms by which teacher creativity can be enhanced in an understudied context.

Our first model demonstrated several key findings. First, we found that there is a positive and significant relationship between LMX and teacher trust and a negative and significant one between LMX and workplace stress. Confirming the previous research, this means that the quality of a dyadic relationship between the leader and teacher can foster a trusting relationship among teachers (Bowler et al., 2018; Lau & Liden, 2008) and can also reduce the experienced stress because of the burden of the job (Liang et al., 2022; Wilson et al., 2010). Second, our research indicated that increased trust among teachers is closely related to work engagement. This confirms previous researchers' suggestions of a positive relationship between the two concepts (Chughtai & Buckley, 2008). It suggests that principals build trust by showing genuine care for teachers' well-being, involving them in decisions, and fostering a

sense of respect and inclusion, which collectively enhance teachers' professionalism, motivation, and commitment (Tschannen-Moran & Gareis, 2015). Combined with previous research (Lau & Liden, 2008), this suggests that as trusting relationships increase, a teacher may develop confidence in their colleague's good intentions, which encourages them to work hard in school.

Third, our research revealed a positive and significant relationship between stress and strain. This implies that when a teacher experiences workplace stress, their reaction is highly likely to be psychological strain, consistent with previous research that finds strain is a typical outcome of workplace stress (Beehr & O'Hara, 1987; Cummings & Cooper, 2013; Francis & Barling, 2005). However, contrary to our expectations based on the stressor–strain–outcome model (Koeske & Koeske, 1993), which predicts a negative relationship between psychological strain and work engagement, we found a positive and significant relationship. This suggests that an increase in teacher strain is likely to promote their engagement in their work. Conversely, our findings align with those of Breevaart and Bakker (2018), which indicate a positive correlation between job demand factors and work engagement, contingent on a dynamic and individualised approach to leadership that is oriented towards followers. This might imply that a certain level of stress and strain is necessary to keep teachers alert and, consequently, increase their engagement (Breevaart & Bakker, 2018).

Fourth, while work engagement is positively related to creativity, strain is only weakly but negatively related to creativity. This suggests that teachers' mental dedication and energy directed towards their work in school will support them in generating novel ideas and hence fostering creativity (Demerouti & Cropanzano, 2010; Martinez, 2015; Shuck et al., 2017). This is because cognitive engagement allows individuals to rethink what they know, expand their perspectives, and generate innovative ideas (Fredrickson, 2001). However, those who spend their time and energy on tackling stress will not have the mental state to produce new and original strategies or ideas (Zhang et al., 2021). Psychological strain stems from depleted emotional and physical resources and therefore limits thinking capacity, promotes routine behavior, lowers motivation, and diminishes employees' engagement in creative work (Koeske & Koeske, 1993; Van Dyne et al., 2002).

Our research also indicated several indirect associations. First, we found that the total indirect association between teacher trust and creativity, mediated by teacher engagement, is positive and significant. This was the strongest indirect relationship in terms of size, suggesting that the teacher's engagement, driven by trust, can foster the teacher's capacity to generate innovative ideas, supporting the findings of Bryk and Schneider (1996, 2002). Second, the indirect relationship between stress and creativity is not (or only one-tailed) significant, given the limited association between psychological strain and teacher creativity. This suggests that stress will not be significantly related to teacher creativity, as there is no indirect relationship, unlike previous research (Koeske & Koeske, 1993).

An interesting finding is that workplace stress may even contribute positively to teacher creativity through its indirect link to engagement via psychological strain. This effect mainly arises from the positive association between strain and work engagement. Notably, we conceptualised teacher stress as arising from work overload, excessive demands, and work discontent. These dimensions closely align with

the challenge stressors identified by Lepine et al. (2005) within the Challenge–Hindrance Stressor Framework (CHSF), which employees generally perceive as fostering personal growth and achievement (Podsakoff et al., 2007). In this regard, Podsakoff et al. (2023, p. 173) state: “*Research suggests that whereas challenge stressors tend to have positive relationships with variables that serve as countervailing mechanisms of the effects of these stressors on employee performance-related behaviors through strains, hindrance stressors tend to have negative relationships with variables that complement their negative effects on outcomes through strains. Thus, it is not surprising that challenge stressors may not always have positive net effects on outcomes, because such effects will materialize only when the positive effects of these stressors through motivation, job attitudes, emotions, or other mechanisms are strong enough to outweigh the deleterious effects of these demands through strains*”. This is an effect we also observe, which supports the integration of the JD-R model and the CHSF in future studies.

Finally, our model suggests that LMX is a strong component of schools to boost teacher creative behavior. Partially supporting previous frameworks (Tummers & Bakker, 2021), our analysis suggests that job resources are the primary pathway through which the link between LMX and teacher creativity can be strengthened. The relationship between LMX and teacher creativity, mediated by job demand, is either positive through engagement or negative through strain; however, this association is either very small or insignificant, rendering the link between LMX and creativity almost insignificant, contrary to expectations (Bakker et al., 2004; Tummers & Bakker, 2021). We believe this highlights the need for additional quantitative studies across contexts to establish a robust argument about the influence of LMX via the job demand path.

Our analysis did not support a moderating role for LMX in the relationships between job resources and work engagement, or between job demand and psychological strain. Unlike the research showing that high leadership strengthens the association between job demands and work engagement (Breevaart & Bakker, 2018), our work found that neither high nor low LMX alters the strength of the relationships between stress and constraints, or between teacher trust and engagement. In this regard, while the results of this study support the JDR framework in general (Bakker et al., 2023; Demerouti & Bakker, 2023; Mazzetti et al., 2023; Radic et al., 2020; Tummers & Bakker, 2021), it does not confirm the framework proposed by Tummers & Bakker (2021). Nevertheless, the results further suggest that LMX is moderately related to teachers’ creativity in the broader context, even if we were unable to demonstrate any specific moderation. This may indicate that the relationship between principals and teachers is a highly relevant climate variable for the individual teacher, shaping perceptions and actions across all JD-R domains and individual outcomes.

6.1 Limitations and implications for research

While addressing a substantial issue in educational leadership in an understudied context, the present research involves several limitations that need attention. First, the results are based on cross-sectional data collected at a single point in time, which limits the ability to draw causal implications regarding how LMX, in conjunction

with other job resources and demands variables, may be related to teacher creativity. Experimental or longitudinal studies are necessary to support such claims.

Second, the teacher creativity scale was developed based on the extent to which teachers generate creative ideas and solutions. An alternative might be to use creative thinking (e.g., if you could design an innovative learning environment, what features would it include?; Patterson et al., 2024) to measure the scope of teacher creativity. The existing literature in educational research provides only limited results for some of the variables examined here. This is particularly the case for the constructs of horizontal teacher trust, teachers' work engagement, psychological strain, and LMX. Further research is needed to gain a more detailed understanding of these constructs, including their measurement, antecedents, effects, and the contingency factors that influence them.

Moreover, as with many studies that measure teacher trust, the present research relies on a referent ("colleagues at my school") that may include both peers and school leaders. While this is consistent with established scales such as the Omnibus T-Scale (Hoy & Tschannen-Moran, 2003) and with broader traditions of trust measurement in organizational research that refer to "co-workers" or "colleagues," it may blur the distinction between horizontal and vertical trust. In many school contexts, however, leadership and teaching roles are not strictly separated, which makes it difficult to isolate purely horizontal trust relationships. Future research should further explore this conceptual distinction and develop measures that better capture the nuances of trust dynamics in schools.

Another avenue for future research arises from the unexpected finding of a positive relationship between stress, psychological strain and work engagement. We conceptualised stress as arising from work overload, excessive demands and work discontent—that is, challenge stressors within the Challenge–Hindrane Stressor Framework (Lepine et al., 2005). However, the framework also recognises hindrance stressors, which are stressors that employees tend to appraise as potentially constraining their personal development and work-related accomplishments, such as role conflict, resource inadequacies and administrative hassles (Podsakoff et al., 2023). We did not measure this. Thus, an explicit integration of the JD-R and CHSF models seems to be a promising avenue for future research seeking to understand the nuanced and often contradictory effects of work-related stress in schools by systematically differentiating between 'challenge' and 'hindrance' stressors. Ultimately, this would yield more differentiated and actionable recommendations for the management of job demands and resources in schools.

Finally, to the best of our knowledge, this is the first article in education to link LMX to job sources and demand factors, as well as creativity in schools; however, the findings are based on a single nation. Further research from other nations, employing a similar conceptual model, may be necessary to establish a more robust argument regarding the significance of relationships among the constructs used in the present study.

6.2 Conclusion and implications

In conclusion, our model confirms both self-determination and social exchange theories by providing evidence of an indirect link between LMX and teacher creativity. Consistent with self-determination theory, our analysis indicated that LMX can promote a teacher's positive experience, such as trust, ultimately resulting in heightened motivation for engagement and creativity. Similarly, it confirms social exchange theory assumptions by indicating that positive social exchange between the leader and teachers in a school can provide teachers with various benefits, such as increased trust among teachers and reduced stress. Teachers, in return, reciprocate with increased dedication to work and the generation of novel ideas, insights, and solutions. Moreover, this study highlights the importance of fostering supportive relationships and a conducive work environment to enhance teacher creativity. We conclude that school leaders should prioritize nurturing interpersonal relationships to enhance trust among teachers and effectively manage their stress, which then can contribute to the creation of a positive and dynamic teaching environment, and consequently more dedicated and creative teachers.

Our study highlights key issues in educational leadership within an understudied context, noting that Kyrgyzstan's centralized educational system might influence the findings. For policymakers in Kyrgyzstan, these results suggest several strategies to improve school conditions. Firstly, there is a need to develop and implement professional development programs tailored specifically for school leaders, focusing on enhancing interpersonal skills. Secondly, the selection process for school leaders must be reformed to prioritize soft skills alongside knowledge-based criteria, as these are crucial for fostering high-quality relationships with educators. Ensuring school leaders possess these capabilities can lead to greater trust and reduced teacher stress. Additionally, policies aimed at reducing hierarchical rigidity while promoting autonomy and collaborative cultures within schools could be beneficial. Such policies would help school leaders create safer and more trusting environments conducive to creative teaching practices. Furthermore, integrating support mechanisms for mental health and stress management into school policies is vital. These mechanisms can alleviate psychological strain, thereby enhancing teacher engagement and creativity, ultimately contributing to a more productive and supportive educational environment.

For practitioners in Kyrgyz schools, the study emphasizes the importance of creating a supportive and collaborative environment. Teachers should prioritize building trust and open communication among colleagues through regular team activities and discussions, creating a foundation for mutual support. Managing workplace stress through effective time management, self-care practices, and seeking feedback and support from school leaders can help maintain mental health and professional well-being. Overall, our research indicates that LMX can be a significant driver of change and innovation in schools, particularly by promoting trust between teachers, reducing work-related stress, and shaping teachers' perceptions and actions within schools. It is yet to be determined what role the quality of the leader-teacher relationship plays in transforming creative ideas into classroom innovations.

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Declarations

Conflict of interest The authors have no competing interests to declare that are relevant to the content of this article.

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