

Pedagogical knowledge absorptive capacity and LMX as proactive and strategic approaches to work engagement and teacher creativity: a job demands-resource perspective

Marcus Pietsch ^a, Donnie Adams ^{b,c}, Mehmet Şükrü Bellibaş^{a,d}
and Vasu Muniandy ^e

^aInstitute of Educational Sciences, School of Education, Leuphana University, Lüneburg, Germany; ^bFaculty of Education, University of Melbourne, Melbourne, Australia; ^cSchool of Education, Faculty of Social Sciences and Leisure Management, Taylor's University Lakeside Campus, Subang Jaya, Malaysia; ^dDepartment of Education, College of Arts, Humanities and Social Sciences, University of Sharjah, Sharjah, UAE; ^eMinistry of Education, Institute Aminuddin Baki, National Institute of Educational Leadership and Management, Bandar Enstek, Malaysia

ABSTRACT

Teacher creativity is widely recognised as a key driver of educational innovation, shaped by work engagement and proactive individual behaviours. Drawing on the extended Job Demands – Resources (JD-R) theoretical framework, this study examines how the quality of leader – member exchange (LMX) and proactive pedagogical knowledge absorptive capacity (PACAP) affect teacher engagement and creativity. Survey data were collected from 3,016 teachers across 151 public schools in Malaysia. Structural Equation Modelling results reveal that high-quality LMX relationships significantly enhance innovation self-efficacy, reduce workplace stress, and strengthen teacher trust, which in turn, contribute to higher levels of work engagement and creativity. Furthermore, PACAP was also found to be significantly associated with innovation self-efficacy and teacher trust, highlighting its role as an essential personal resource in enhancing teachers' creativity and pedagogical practices. This study highlights the pivotal role of leadership and PACAP in fostering innovative teaching practices and improving teacher performance.

ARTICLE HISTORY

Received 9 July 2025
Accepted 26 March 2026

KEYWORDS

Pedagogical knowledge absorptive capacity; LMX; work engagement; teacher creativity; JD-R; innovation self-efficacy

Introduction

In the current knowledge society, the success of schools relies heavily on their ability to innovate and adapt to increasing societal and educational demands (J. Levin et al. 2026; Pan, Lin, and Chung 2024; Pietsch, Tulowitzki, and Cramer 2023). This involves adopting new pedagogical approaches, integrating innovative teaching practices, and utilising digital tools to promote active student learning; initiatives intrinsically linked to teacher creativity (Bellibaş et al. 2024b; J. Levin et al. 2026; Ugwuanyi, Bellibaş, and Pietsch 2025).

CONTACT Donnie Adams  donnie.adams@unimelb.edu.au  Faculty of Education, University of Melbourne, Melbourne, Australia

© 2026 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group.

This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivatives License (<http://creativecommons.org/licenses/by-nc-nd/4.0/>), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited, and is not altered, transformed, or built upon in any way. The terms on which this article has been published allow the posting of the Accepted Manuscript in a repository by the author(s) or with their consent.

As a key driver of educational innovation, teacher creativity helps schools sustain competitiveness and fosters effective student learning (Adams et al. 2025). Furthermore, teaching creativity is associated with positive student outcomes, including higher academic achievement and improved motivation (Beghetto and Kaufman 2017). Consequently, understanding the stimulants of teacher creativity is essential for improving educational practices.

A fundamental factor in fostering creativity is pedagogical content knowledge, which supports innovative instructional practices (König and Pflanzl 2016). Specifically, individual absorptive capacity (ACAP) for pedagogical knowledge is highly relevant, as it involves the ability to effectively identify, assimilate, and apply new external knowledge (Schweisfurth and Raasch 2018; Xiong et al. 2024). ACAP is the ability to use valuable knowledge from the external environment, which can play a pivotal role in someone's effectiveness in learning and exploiting new knowledge (Xiong et al. 2024). Teachers with a high ACAP actively incorporate innovative methods, enhancing both their instructional creativity and adaptability to educational challenges (Cohen and Levinthal 1990; Da'as and Qadach 2020). While ACAP can be analysed organisationally, focusing on individual ACAP provides unique insights into how teachers apply knowledge to improve teaching outcomes (Schweisfurth and Raasch 2018).

Moreover, work engagement is essential for enabling teachers to leverage their ACAP (A. B. Bakker and Leiter 2017). Engaged teachers, characterised by high energy, mental resilience, and dedication to their profession, are more motivated to innovate in their teaching practices (Schaufeli et al. 2002; Tummers and Bakker 2021). However, this engagement is influenced by several factors, including self-efficacy and trust in colleagues' goodwill (Tan and Lim 2009; Tummers and Bakker 2021). Conversely, high job demands and a lack of support can lead to stress and burnout, which stifle creative potential (Bellibaş, Gümüş, and Chen 2024a). Supportive leadership, particularly through high-quality Leader-Member Exchange (LMX) relationships, plays a crucial role in mitigating these stressors (Graen and Uhl-Bien 1995). LMX is the quality of the dyadic relationship between the leader and the follower within a complex organisational context (Graen and Uhl-Bien 1995). LMX, characterised by mutual respect and support, enhances work engagement by reducing job demands and fostering a positive work environment (Erdogan and Bauer 2014; J. Levin et al. 2026).

Despite the importance of these variables, concepts such as ACAP and innovation self-efficacy remain understudied in educational research (Adams et al. 2025; J. Levin et al. 2026). Existing studies have largely examined these relationships in isolation, often focusing on single mediating mechanisms like trust or workload rather than treating teacher creativity as a multidimensional outcome (Adams et al. 2025). Furthermore, prior work has paid limited attention to how these factors operate simultaneously within an integrated framework capturing both enabling and constraining conditions.

This study addresses this critical gap by moving beyond fragmented examinations of leadership effects to test an integrated model. Unlike prior research focusing on single mediators, this study incorporates ACAP, work engagement, trust, innovation self-efficacy, and work stress within a unified framework. Specifically, we examine the interrelationships among work engagement, workplace stress, and LMX, highlighting how they collectively foster an environment conducive to teacher creativity. By doing so, we

underscore the relevance of ACAP and trust as mediators in enhancing teacher engagement and creativity within a centralised Southeast Asian education system.

Theoretical framework

In this research, we employed the Job Demands-Resources (JD-R) theoretical framework that links leadership to work engagement and performance (A. Bakker 2017; A. B. Bakker and Leiter 2017; A. B. Bakker and Xanthopoulou 2013). This link includes both top-down and bottom-up approaches. The top-down approach is through leaders shaping demand and resource variables in the workplace. Job demands are aspects of a job that require sustained effort and entail physical or psychological costs. Resources could be personal or job-related. Job resources are defined as the physical, social, or organisational aspects of a job that can alleviate job demands, support the achievement of work goals, or foster personal growth (A. Bakker 2017; A. B. Bakker and Leiter 2017) while personal resources refer to positive self-evaluations linked to resilience and self-efficacy (Hobfoll et al. 2003). The bottom-up approach refers to proactive employee behaviours that reshape job demands and resources, such as seeking feedback or taking on new challenges (A. B. Bakker and Leiter 2017).

Following these theoretical works on JD-R (A. B. Bakker and Leiter 2017), we focus in the present research on LMX and its relationship with teachers' work engagement and creativity (see Figure 1). We propose that LMX, as a critical aspect of leadership in schools, can enhance job and personal resources and influence job demands, which, in turn, affect teachers' engagement at work and their creative behaviours. Specifically, in this study, teacher trust is conceptualised as a job resource, innovation self-efficacy is treated as a personal resource, and stress is identified as the primary job demand. Furthermore,

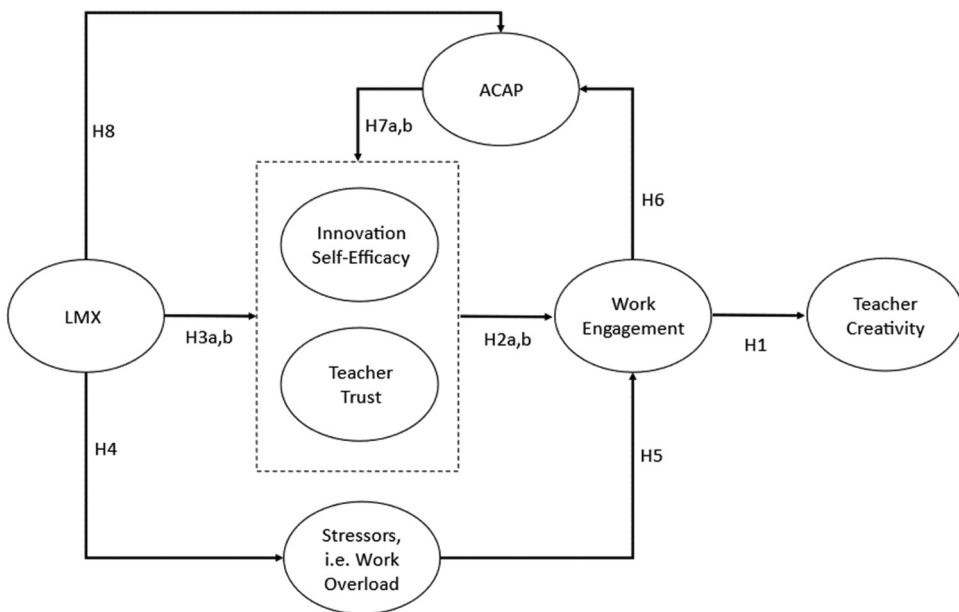


Figure 1. Conceptual framework of the present study.

following A. B. Bakker and Leiter (2017), we propose ACAP as a proactive, bottom-up process shaped by work engagement and closely linked to the availability of personal and job resources.

The following section briefly overviews each concept within the theoretical framework and presents the rationale for the proposed links and associated hypotheses.

Teacher creativity

Creativity is defined as generating novel and useful ideas or solutions (Zhou and George 2001). Creative people are known for frequently attempting to develop novel and better ways of doing things (Zhou and George 2003) and to think outside the box. It involves developing or producing ideas challenging the status quo (Zhou and George 2003).

Work engagement

Work engagement is a positive, fulfilling, affective-motivational state of work-related well-being that is characterised by vigour, dedication, and absorption (A. B. Bakker and Leiter 2017). Vigour points to “high levels of energy and mental resilience while working, the willingness to invest effort in one’s work, and persistence even in the face of difficulties” while dedication refers to “feelings of a sense of significance, enthusiasm, inspiration, pride, and challenge”; and finally absorption means “being fully concentrated and deeply engrossed in one’s work, whereby time passes quickly and one has difficulties with detaching oneself” (Schaufeli et al. 2002, 74–75).

Innovation self-efficacy

Teacher self-efficacy (TSE) refers to teachers’ judgement of their ability to achieve desired outcomes, even with difficult or unmotivated students (Tschannen-Moran and Hoy 2001). While TSE is a general concept, there is a growing tendency to develop and utilise more nuanced concepts related to self-efficacy that focus on teachers’ perceptions of their ability to carry out a specific aspect of their job, such as classroom management, teaching and student engagement (Tschannen-Moran and Hoy 2001). Similarly, the current study focuses on a specific concept: “innovation self-efficacy” (Schmitz and Schwarzer 2002), which refers to the belief of teachers in their ability to develop and implement new ideas to bring about desired outcomes even when facing serious challenges including sceptical colleagues (Röhl, Pietsch, and Cramer 2024).

Teacher trust

Trust refers to “an individual’s or group’s willingness to be vulnerable to another party based on the confidence that the latter party is benevolent, reliable, competent, honest, and open” (Hoy and Tschannen-Moran 2003, 203). It involves horizontal or vertical directions. Horizontal trust, a less recognised type in research, refers to trust among co-workers (or peers) that does not involve, or has only minor, hierarchy and power imbalances (Tan and Lim 2009). Trust in the present study refers to horizontal

(co-workers) trust, particularly teacher-to-teacher trust (Hoy and Tschannen-Moran 2003).

Workplace stress

Workplace stress is the change in one's physical or mental state in response to workplaces that pose an appraised challenge or threat to that employee (Colligan and Higgins 2006, 89). When the individual cannot cope with the increasing pressure of acute stress, short-term stress that occurs as a reaction to a specific event or situation, for a long period, this stress type can develop into a chronic one and exert a larger impact on the mental and physical health of employees (Petrowski et al. 2019). Chronic stress is the frequency of persistent stressors with unmanageable consequences over time, in the absence of effective coping strategies (Petrowski et al., 2012).

Leader-member exchange (LMX)

LMX develops gradually through repeated work-related interactions between leaders and followers over time (Cunningham and MacGregor 2000) and varies across followers (Sherony & Green, 2002). The underlying assumption of this theory is that effective leadership processes occur when leaders and followers can develop mature leadership relationships and hence gain various benefits from these relationships (Graen and Uhl-Bien 1995; Witthöft et al. 2025).

Absorptive capacity (ACAP)

ACAP refers to the proactive capability of an individual or organisation to evaluate (Cohen and Levinthal 1990) and "identify, assimilate, and apply external knowledge" to generate innovative ideas (Schweisfurth and Raasch 2018, 687). Research on ACAP in education is extremely scarce and focuses on it at the organisational (school) level (Da'as and Qadach 2020). In the present research, we are interested in individual teachers' ACAP, particularly their pedagogical knowledge.

Hypothesis development

Joo et al. (2023) found evidence that work engagement significantly predicts creativity. Individuals lacking intrinsic motivation will not use their knowledge and abilities to produce creative work, even if they possess the necessary skills and potential for creative performance. Affective attachment to work can foster creativity by promoting confidence, optimism, and a sense of meaning, which in turn encourage proactive behaviour and engagement with creative ideas (Harrison, King, and Wang 2023). Teachers with high work engagement are likely to come up with creative ideas (J. Levin et al. 2026)

H1: *Work engagement positively affects teacher creativity.*

Innovation self-efficacy is teachers' belief in their ability to develop and implement new ideas (Röhl, Pietsch, and Cramer 2024). This ability affects cognitive processes and

influences decisions about choosing, investing effort in, and persisting with goal-related activities; hence, it is expected to be related to workplace engagement (Granziera and Perera 2019). If teachers believe they can do something innovative, they tend to develop the motivation to do it.

H2a: *Job resources, i.e. innovation-related teacher self-efficacy, positively affect work engagement.*

Trust is an essential organisational element that could serve as a supportive mechanism for increased engagement (Tan and Lim 2009). When employees feel they can rely on others' goodwill, competencies, and integrity, they will exert more effort at work (D. C. Lau and Liden 2008). When teachers believe in their co-workers' abilities and knowledge, their enthusiasm for hard work will increase, resulting in greater work engagement (J. Levin et al. 2026).

H2b: *Job resources, i.e. horizontal teacher trust, positively affect work engagement.*

Within a positive dyadic relationship, employees who establish a trust-based relationship with the leader will be driven to enact in a trustworthy manner (Bowler et al., 2018) based on two underlying assumptions: first, employees will feel a sense of responsibility to uphold their leaders' trust by acting reliably and second they will want to perform well and become more capable in co-workers' eyes in return for leaders' support for the trusted employees (D. C. Lau and Liden 2008). Similarly, when a teacher engages in a good dyadic relationship with a leader, the positive environment produced from this relationship can help them enact in a trustworthy manner with other teachers (J. Levin et al. 2026)

H3a: *LMX (Leadership) will positively affects (raises) trust among teachers*

The dyadic relationship between the leader and followers could reinforce employees self-efficacy perspectives, particularly concerning innovation. Innovation self-efficacy is the belief in one's ability to produce creative outcomes (Modliba et al. 2024). LMX enhances this belief by encouraging employees' positive perceptions of the climate and giving a sense of empowerment (Modliba et al. 2024). This is primarily due to the mutual relationship between supervisors and subordinates, grounded in reciprocal respect.

H3b: *LMX (Leadership) will positively affects (raises) innovation self-efficacy.*

A positive relationship based on mutual trust can positively influence the employee's emotions and wellbeing (J. Levin et al. 2026). Researchers claimed that key stressors in the workplace including work discontent, high work demands, social isolation, etc. (Schulz, Schlotz, and Becker 2004), could be minimised through a high-quality dyadic relationship between the leader and employee (J. Levin et al. 2026) because, in the instance of a high-quality relationship with the leader, employees will benefit from a variety of job resources including social support that

will reinforce positive mental state and reduce the chance for the emergence of work stress.

H4: *Strategic Management of Work Engagement, i.e. LMX (Leadership), negatively affects (lowers) job demands.*

Employees who are physically and emotionally exhausted due to increased workload, time pressure (Demerouti et al. 2001), work discontent and social isolation (Schulz, Schlotz, and Becker 2004) are likely to suffer from reduced energy and dedication to work (Zacher & Winter, 2011). A stressful workplace would diminish cognitive capacity; foster routine work behaviours; and reduce motivation for more challenging work that requires energy, all of which can preclude creative behaviour (Van Dyne et al. 2002). Particularly when teachers have a strong sense of stress due to pressure in the workplace, they are less likely to engage in their work (J. Levin et al. 2026)

H5: *Job demands, i.e. stressors, negatively affect Work Engagement.*

Engaged employees fully concentrate on their work (Schaufeli et al. 2002). They put much effort into their work because they deeply identify with it. Therefore, they are more likely to utilise job crafting behaviours, proactively mobilising their job resources (A. B. Bakker and Leiter 2017). Consequently, work engagement is closely related to motivation to seek, identify, and apply new workplace knowledge (Contreras and Baykal 2021).

H6: *Work Engagement positively affects individual ACAP.*

Since ACAP is concerned with new knowledge that exists in the external environment (Schweisfurth and Raasch 2018) and may not be within the organisation, this new knowledge could have substantial potential to increase employees' perceived capabilities to generate creative ideas and practices (A. K. Lau and Lo 2015). The process of seeking and eventually exploiting external knowledge might also enhance employee trust. Employees with high ACAP can quickly enhance their skills, enabling them to achieve personal goals (Schweisfurth and Raasch 2018).

H7: *Proactive Management of Work Engagement, i.e. Individual ACAP, positively affects job resources (innovation self-efficacy and co-worker trust).*

The quality of the dyadic relationship between leaders and employees (Erdogan & Liden, 2002) can support employees' motivation to engage in job-crafting activities, including ACAP (A. B. Bakker and Leiter 2017). This may require employees to acquire external knowledge. In such cases, a good dyadic relationship could ultimately support employees' motivation to identify, assimilate, and apply external knowledge" to generate innovative ideas (Schweisfurth and Raasch 2018, 687) to please the leader (Martin et al. 2016).

H8: *LMX (Leadership) positively affects individual ACAP.*

Methods

Context and sample

Malaysia has a bureaucratic, centralised education system. The Ministry of Education (MoE) regulates and oversees the appointment of teaching staff and school principals, curriculum designs, teacher training and development, and budgeting (Adams and Tan 2022). School leaders in Malaysia are expected to serve as instructional leaders and to manage the school curriculum, co-curricular planning, and school budgets (Harris et al. 2017), while teachers implement a predetermined curriculum. The Malaysian Education Blueprint 2013–2025 (Ministry of Education Malaysia 2012) was formulated to transform its education system to meet international standards and align it to the demands of the twenty-first century.

The targeted population in this study were teachers from public schools. A three-stage stratified random sampling approach was adopted for this study. First, schools located in eight states across the north, south, east, central, and west of Malaysia were identified. Next, we classified schools by their type (e.g. primary and secondary schools; urban and rural) within these states. We aimed to include at least 10 teachers from schools with larger teaching staff (e.g. more than 50 teaching staff), whereas in smaller schools we included all available teachers. This sampling approach ensured that the data was representative of the diverse educational contexts across Malaysia, providing insights into teacher experiences in both urban and rural settings.

A total of 3016 teachers from 151 schools participated in the study, representing a response rate of 35% out of the 8,736 teachers we contacted. About 27.5% ($n = 829$) of the teachers were from rural schools, and 72.5% ($n = 2187$) were from urban ones. As for gender, respondents were largely women 83.2% ($n = 2508$), and 16.8% ($n = 508$) were men.

Measures

Leader member exchange. (LMX, $\omega^1 = 0.926$). LMX was measured with an adaptation of Graen and Uhl-Bien's (1995) seven-item LMX scale. An example item is "How would you characterize your working relationship with your principal?", coded from 1 (Extremely ineffective) to 5 (Extremely effective). Another item is "Regardless of how much formal authority your principal has built into his or her position, what are the chances that your principal would use his or her power to help you solve problems in your work?", also coded from 1 (None) to 5 (Very high).

Absorptive capacity. (ACAP, $\omega = 0.963$). To assess teachers' individual ACAP, the uni-dimensional six-item scale from Schweisfurth and Raasch (2018) was adapted, as it is capable of capturing domain-specific ACAP. All items were measured on a four-point Likert-type scale, coded from 1 (strongly disagree) to 4 (strongly agree). The objective was to assess teachers' ACAP about pedagogical knowledge, as defined by Shulman (1986). We asked teachers to indicate how much they agreed with each statement. An

example of an item was “I am always searching for new knowledge about teaching and learning to raise student achievement”. An example item for assimilating pedagogical knowledge is “I translate new knowledge about teaching and learning into a language that my colleagues understand”. An example item for applying pedagogic knowledge is “I exploit new knowledge about teaching and learning to change instruction fundamentally”.

Innovation self-efficacy. (ISE, $\omega = 0.884$). Teachers’ self-efficacy related to innovation was measured using four items from Röhl, Pietsch, and Cramer (2024). 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 know that I can carry out innovative projects, even when I am opposed by skeptical colleagues”.

Teacher trust. (TTR, $\omega = 0.884$). The teacher’s trust in their colleagues was captured with four items adapted from Dederling and Pietsch (2025). Following Tan and Lim (2009), these items assess horizontal trust, indicated by 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 are very competent in their jobs”.

Workplace stress. (WST, $\omega = 0.891$). The stress experienced at school was measured 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). These items pertain 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: Schulz, Schlotz, and Becker 2004) “I have too little time to perform my daily tasks”.

Work engagement. (ENG, $\omega = 0.911$). We assessed teachers’ work engagement 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, i.e. vigour, dedication, and absorption. 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. dedication) “My job inspires me”.

Teacher creativity. (TCR, $\omega = 0.919$). Teachers’ self-reported creativity in the workplace was measured using three items from George and Zhou (2001). All items were answered on a 4-point Likert-type scale (1 = strongly disagree, 4 = strongly agree). An example item is “I come up with creative solutions to problems”.

Data analyses

The *Mplus* 8.5 software (Muthén & Muthén, 2017) was utilised for the analyses, with confirmatory factor analyses (CFAs) and structural equation models (SEMs) subsequently estimated. Maximum likelihood estimation with robust (Huber-White) standard errors (MLR) was employed, and cluster-robust standard errors were requested by specifying TYPE = COMPLEX, since teachers were nested within schools. As we

assume a recursive path in the SEM, we do not estimate random effects (i.e. latent interactions). This is because including latent interactions in such a model renders the model non-estimable due to reciprocal interaction problems (Asparouhov 2013).

Although the data have a hierarchical structure (teachers nested within schools), all constructs in the present study were conceptualised and measured exclusively at the individual level. As our research questions focus on teacher-level relationships and no hypotheses were specified at the school level, we did not estimate a full multilevel model. Instead, we accounted for the non-independence of observations by using the COMPLEX option in *Mplus*, which provides cluster-robust standard errors and a corrected χ^2 test statistic. This design-based approach is considered appropriate when between-cluster variance is not of substantive interest and the analysis targets individual-level associations (Asparouhov 2005; Muthén and Asparouhov 2018). Consistent with recommendations by both Marsh et al. (2012) and Lüdtke et al. (2008), multilevel modelling is primarily required when researchers aim to disentangle within- and between-level effects or to investigate contextual influences; if such effects are not theoretically relevant, adjusting standard errors for clustering is sufficient.

We used the standardised root mean square residual (SRMR) and the comparative fit index (CFI) to assess the goodness of fit of the basic path model. The cut-offs for SRMR and CFI were 0.08 and 0.90, respectively (Hu and Bentler 1999). We did not use the root mean square error of approximation (RMSEA) to assess model fit because it is sensitive to the method used to estimate the model parameters and shows worse performance with ordinal indicators (Shi and Maydeu-Olivares 2020).

The SEM analyses are based on the theoretical model outlined in the literature review, with hypothesised relationships among LMX, ACAP, work engagement, stress, trust, innovation self-efficacy, and teacher creativity. All constructs are measured at the individual level, and the original instrument scaling is retained to preserve validity.

In the SEM section, β refers to standardised regression coefficients from the structural equation model. Standardised β values indicate the strength and direction of the relationships between latent variables on a standardised scale, allowing comparison across paths within the model (Kline 2016). Reporting standardised coefficients, along with p -values, enables evaluation of both statistical significance and practical effect size.

We further tested the robustness of the mediation effects using bootstrapped mediation analysis, which provides 95% bias-corrected bootstrap confidence intervals based on 1,000 bootstrap replications (Hayes 2018). Indirect effects are significant if the 95% confidence intervals (95% CIs) do not include zero (Hayes 2018).

Our data originate from a single instrument, so we initially examined the common variance by loading all items utilised in the analyses on a single unrotated factor (Harmann 1960). If the value determined here is less than 50%, it is highly unlikely that method bias in model estimates due to common variance is to be expected (Lance et al. 2010). Our data show that the common variance is 34.6%. Accordingly, it can be assumed that no common method bias is present. As the amount of missing data was less than 0.5%, we employed a full information maximum likelihood approach (FIML) to handle it.

Findings

The structural equation model showed an acceptable fit with the data (CFI = 0.92, SRMR = 0.07). An analysis of the modification indices revealed an additional relevant, unmodeled direct relationship between teachers' innovation-related self-efficacy (ISE) and their creativity. Adding this parameter slightly increased the model fit (CFI = 0.93, SRMR = 0.05). However, because these parameters were not consistent with our conceptual model, we did not include them in our analyses.

Descriptive statistics

The result of the descriptive table showed that the overall mean values are high. LMX has a mean value of $M = 3.68$ ($SD = 0.72$), ACAP of $M = 3.28$ ($SD = 0.53$) and ENG of $M = 3.28$ ($SD = 0.53$). STR demonstrated a mean value of $M = 2.46$ ($SD = 0.71$). In addition, latent correlation analysis in MPLUS showed that all associations among variables are significant, ranging from a high of 0.648 between ISE and ENG to a low of -0.58 between TTR and STR (see Table 1).

Structural equation model (SEM)

The first model estimation aimed at estimating the direct effects. We developed an SEM to examine the interrelationships between LMX, teacher creativity, work engagement, workplace stress, ACAP in pedagogical knowledge, innovation self-efficacy, and trust. This model doesn't include the mediation or moderation effects. The results of the SEM indicated a good fit of the proposed model to the data (CFI = 0.924, SRMR = 0.065). The estimation of the standardised regression coefficients yielded the following results: Work Engagement $\rightarrow$ Teacher Creativity ($\beta = 0.601$, $p < .000$); Innovation Self Efficacy $\rightarrow$ Work Engagement ($\beta = 0.486$, $p < .000$); Teacher Trust $\rightarrow$ Work Engagement ($\beta = 0.225$, $p < .000$); Stress $\rightarrow$ Work Engagement ($\beta = -0.128$, $p < .000$); LMX $\rightarrow$ Innovation Self Efficacy ($\beta = 0.416$, $p < .000$); ACAP $\rightarrow$ Innovation Self Efficacy ($\beta = 0.169$, $p < .000$); LMX $\rightarrow$ Teacher Trust ($\beta = 0.317$, $p < .000$); ACAP $\rightarrow$ Teacher Trust ($\beta = 0.109$, $p < .01$); LMX $\rightarrow$ Workplace Stress ($\beta = -0.147$, $p < .000$); Work Engagement $\rightarrow$ ACAP ($\beta = 0.420$, $p < .000$). LMX $\rightarrow$ ACAP ($\beta = 0.206$, $p < .000$). Since all relationships in the model are significant, this result confirms all hypotheses from H1 to H8. Additionally, the significant relationship between ENG and ACAP, between ACAP and both ISE and TTR, and between both TTR and ISE and ENG provides evidence of a reciprocal effect. The model variables account for 36.1%, 47.6%,

Table 1. Descriptive statistics and correlations.

	M	Min-Max	SD	LMX	ACAP	ISE	TTR	STR	ENG	TCR
LMX	3.68	1–5	0.72	1						
ACAP	3.28	1–4	0.53	0.344	1					
ISE	3.09	1–4	0.51	0.474	0.487	1				
TTR	3.18	1–4	0.54	0.354	0.359	0.501	1			
STR	2.46	1–4	0.71	-0.147	-0.106	-0.079	-0.058	1		
ENG	3.28	1–4	0.53	0.329	0.561	0.648	0.502	-0.180	1	
TCR	3.12	1–4	0.50	0.198	0.337	0.390	0.301	-0.108	0.601	1

Note: All correlations $p < .001$; LMX = Leader-Teacher Exchange; ACAP = Individual Absorptive Capacity; ISE = Innovation-related Self-Efficacy; TTR = Horizontal Teacher Trust; STR = Workplace Stress; ENG = Work Engagement; TCR = Teacher Creativity.

Table 2. Standardised direct and indirect effects from the structural equation model (SEM).

Predictor → Outcome	Direct Effect β	Indirect Effect β	95% CI (Indirect)	P	R ²
Work Engagement → Teacher Creativity	0.601	0.028	[0.009, 0.041]	<.001	0.361
Innovation Self-Efficacy → Work Engagement	0.486	0.306	[0.231, 0.381]	<.001	0.476
Teacher Trust → Work Engagement	0.225	0.142	[0.088, 0.193]	<.001	0.476
Stress → Work Engagement	-0.128	-0.081	[-0.116, -0.047]	<.001	0.476
LMX → Innovation Self-Efficacy	0.416	0.198	[0.154, 0.248]	<.001	0.309
ACAP → Innovation Self-Efficacy	0.169	0.067	[0.018, 0.113]	<.001	0.309
LMX → Teacher Trust	0.317	–	–	<.001	0.167
ACAP → Teacher Trust	0.109	–	–	<.010	0.167
LMX → Workplace Stress	-0.147	–	–	<.001	0.022
Work Engagement → ACAP	0.420	–	–	<.001	0.337
LMX → ACAP	0.206	–	–	<.001	0.337
ACAP → Work Engagement	–	0.112	[0.029, 0.184]	<.001	–
LMX → Work Engagement	–	0.329	[0.274, 0.388]	<.001	–

Note: Direct effects are standardized regression coefficients from the SEM. Indirect effects were estimated via bootstrapped mediation analysis with 1,000 replications (Preacher & Hayes, 2008). R² indicates variance explained in endogenous variables. All effects reported are significant at $p < .05$.

30.9%, 16.7%, 33.7% and 2.2% of the explained variance in TCR, ENG, ISE, TTR, ACAP, and STR, respectively.

Mediation analysis

After the direct effects model, we re-estimated another SEM by employing a bootstrapping procedure with 1,000 replications to estimate total indirect effects, the sum of all indirect and partially indirect effects (Preacher & Hayes, 2008). The analyses demonstrate a significant total indirect effect of LMX ($\beta = 0.198$, 95% CI [0.154, 0.248], $p < .000$) on teacher creativity. In addition, the indirect effect of ACAP on Teacher Creativity ($\beta = 0.067$, 95% CI [0.018, 0.113], $p < .000$); Innovation Self Efficacy on Teacher Creativity ($\beta = 0.306$, 95% CI [0.231, 0.381], $p < .000$); Trust on Teacher Creativity ($\beta = 0.142$, 95% CI [0.088, 0.193], $p < .000$); Stress on Teacher Creativity ($\beta = -0.081$, 95% CI [-0.116, -0.047], $p < .000$); Work Engagement on Teacher Creativity ($\beta = 0.028$, 95% CI [0.009, 0.041], $p < .000$), LMX on Work Engagement ($\beta = 0.329$, 95% CI [0.274, 0.388], $p < .000$), ACAP on Work Engagement ($\beta = 0.112$, 95% CI [0.029, 0.184], $p < .000$) were all significant, with the indirect effect of STR on TCR is negative and ENG on TCR the smallest effect. The result showed that all indirect relationships were significant. The findings of our SEM are reported in Table 2.

Discussion

The present study examined strategic and proactive approaches to ENG, TCR, TSR, and LMX, highlighting how these factors collectively foster an environment conducive to TCR. By doing so, we highlight the relevance of ACAP in pedagogical knowledge and TTR, alongside ISE as mediators, in enhancing ENG and creativity based on the multilevel analysis of the data collected from 3016 teachers in 148 schools across various regions of Malaysia. Our results indicated that teacher ENG is pivotal in enhancing ACAP for pedagogical knowledge and creativity. This result provides supporting evidence that teachers who are engaged in their work can transform existing knowledge into fresh ideas and apply these ideas in their teaching practices (Cohen and Levinthal 1990), thereby encouraging creativity in their instruction (Da'as and Qadach 2020; Skaalvik and Skaalvik 2014).

Furthermore, the results of the present study showed that ENG is significantly influenced by trust, ISE, and stress. Additionally, ACAP for pedagogical knowledge is significantly related to these factors. This interrelationship highlights the importance of interpersonal relationships among teachers. Teachers who feel they can rely on their colleagues' abilities and goodwill can enhance their ACAP and work engagement (D. C. Lau and Liden 2008; Tan and Lim 2009; Tummers and Bakker 2021). Additionally, teachers with high innovation self-efficacy are more confident in their abilities to overcome challenges and achieve their goals, leading to greater engagement in their work (Granziera and Perera 2019). This confidence allows them to integrate new pedagogical knowledge more effectively and creatively into their instruction, confirming previous research that found a positive link between ACAP and creativity (Tian and Soo 2018). Conversely, high job demands can reduce work engagement, causing stress and burnout (Bellibaş, Gümüş, and Chen 2024a). Therefore, school administrators and policymakers must manage job demands effectively to maintain high levels of teacher work engagement and creativity.

The main finding of this study is a significant relationship between LMX and key factors affecting teachers' work engagement and creativity, including innovation self-efficacy, trust, ACAP for pedagogical knowledge, and stress. These findings suggest that high-quality LMX relationships, characterised by mutual respect, trust, and support between leaders and teachers, are more likely to lead teachers to feel confident in their ability to take risks and implement new teaching methods (Bellibaş et al., 2024a). These relationships also contribute to teachers developing their pedagogical skills and applying new pedagogical knowledge in their classrooms (Cohen and Levinthal 1990; J. Levin et al. 2026; Ugwuanyi, Bellibaş, and Pietsch 2025) as leaders who provide resources that can contribute to higher levels of teacher work engagement and creativity (Graen and Uhl-Bien 1995). Additionally, supporting the claims of the past research that a positive relationship between LMX and job performance should be mediated by job resources (autonomy, developmental opportunities, and social support) and employee work engagement (J. Levin et al. 2026) our study indicated that supportive LMX can help manage teacher workload and job demands, ultimately enhancing teacher engagement and creativity and improving educational outcomes (Ugwuanyi, Bellibaş, and Pietsch 2025). We also add to this line of research by providing evidence of the significant role that ACAP plays in mediating the relationship between LMX, work engagement, and creativity.

In sum, drawing on the JD-R perspective (A. Bakker 2017), this study highlights the central role of both LMX and ACAP as proactive and strategic resources that foster work engagement and, ultimately, teacher creativity (A. B. Bakker and Leiter 2017). The findings suggest that high-quality LMX relationships function as a strategic resource that enhances teachers' innovation self-efficacy and trust, which in turn strengthens work engagement. In addition, ACAP emerged as a key cognitive and pedagogical capability that not only directly supports work engagement but also mediates the positive effects of LMX by enabling teachers to acquire, assimilate, and apply pedagogical knowledge more effectively (A. B. Bakker and Leiter 2017). We also found that work engagement plays a central role in linking these resources to teacher creativity. At the same time, job demands, such as work stress, act as a constraining factor, yet their negative effects are mitigated when strong LMX and ACAP are present (A. Bakker 2017; A. B. Bakker and Leiter 2017). Overall,

the results demonstrate that LMX, as a strategic resource, and ACAP, as a proactive resource, jointly operate to enhance teachers' cognitive readiness for innovation, engagement in their work, and finally their creative behaviours.

Limitations and recommendations for future research

This study has several limitations. First, as posited by Zahra and George (2002), the efficacy of ACAP is contingent upon factors such as social integration mechanisms and regimes of appropriability. Since we focused only on work engagement and LMX as activation triggers, future research should explore knowledge-sharing mechanisms and systematic teacher collaboration. Second, we investigated only pedagogical knowledge ACAP, whereas scholars distinguish between content and pedagogical content knowledge (Krauss et al. 2008). Because ACAP serves as the domain-specific "building material" for individual creativity (Schweisfurth and Raasch 2018), investigating these additional domains are essential.

Furthermore, we deliberately omitted control variables to avoid potential bias from endogeneity or the conflation of causal mechanisms (Hünernund and Louw 2025; Hünernund, Louw, and Rönkkö 2025). In line with recommendations for parsimonious, theory-driven models (Becker et al. 2016; Bernerth et al. 2018; Mändli and Rönkkö 2025), we refrained from including potentially atheoretical controls. Future research should incorporate carefully selected, theory-based variables to explore boundary conditions. Finally, the cross-sectional design precludes definitive conclusions regarding causal directionality. While relationships are theoretically grounded, findings remain associative; thus, longitudinal or experimental research is required to establish temporal sequences and causal effects.

Conclusion and implications for policy and practice

This study has contributed to the knowledge base on teaching and teacher development in several ways. First, it confirms both social exchange and JD-R theories by providing evidence on the interrelationships among ENG, STR, and LMX, highlighting how these factors collectively foster an environment conducive to TCR. Second, it emphasised the relevance of pedagogical knowledge, ACAP, and trust, alongside ISE as mediators, in enhancing ENG and TCR. Additionally, it added to the emerging literature within educational research on teachers' ACAP for pedagogical knowledge as a key factor to influence and be influenced by individual and job resource factors. Third, it provided empirical evidence on the relationship between LMX and teacher creativity in schools within a centralised, hierarchical education system in a Southeast Asian country.

The results carry important implications for policy and practice, both within Malaysia and internationally. Consistent with other developing nations, Malaysia is embarking on a reform of its education system aiming to meet international standards and place it within the top one-third of nations in global assessments such as PISA and TIMSS. This research supports such efforts by providing empirical evidence on the factors that could foster an environment conducive to teacher creativity, facilitated by strong relationships with school leaders. Supporting teachers with opportunities to enhance their ACAP and

pedagogical knowledge could be a key policy strategy for the Ministry. This approach cultivates teacher creativity and strengthens the quality of principal-teacher relationships, which together can drive more innovative teaching practices.

Note

1. ω refers to **McDonald's omega**, a reliability coefficient that provides an estimate of internal consistency for each scale, similar to Cronbach's alpha but often considered more accurate, especially for congeneric measures (Dunn, Baguley, and Brunsden 2014; McDonald 1999). Reporting ω allows readers to assess the reliability of the constructs used in the study.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

The work was supported by the Alexander von Humboldt-Stiftung [TUR - 1227776 - HFST-E]; Deutsche Forschungsgemeinschaft [451458391, PI 618/4-1].

Notes on contributors

Marcus Pietsch, PhD, is a DFG Heisenberg Professor of Educational Management and Quality Improvement at Leuphana University Lüneburg, Germany. His research employs quantitative methods to examine school effectiveness, innovation, and educational change from an international perspective, focusing on how leadership, teaching, and learning interact to improve student outcomes in dynamic educational systems.

Donnie Adams is currently based at the Faculty of Education, University of Melbourne. He was recently awarded the ACEL (VIC) Fellowship Award (2025) by the Australian Council for Educational Leaders in recognition of his significant contributions to educational leadership practice and was also awarded the Emerald Young Researcher Award 2021 by Emerald Publishing. He is the Editor-in-Chief of Educational Research and Evaluation (Taylor & Francis), Editor of Cogent Education (Taylor & Francis), and Associate Editor of Leadership and Policy in Schools (Taylor & Francis), all of which are ranked as Q1 journals. Dr Adams is actively involved in research and development work towards the area of inclusive school leadership and school-wide reformation of inclusive education agenda across Asia and Australia.

Mehmet Şükrü Bellibaş, PhD, is a faculty member at the Department of Education, College of Arts, Humanities and Social Sciences at the University of Sharjah, UAE. He is a recipient of the Alexander von Humboldt Foundation's Senior Researcher Fellowship. His expertise is in international and comparative educational leadership, and his research explores how diverse leadership models shape school improvement, influence teacher work behaviours, and enhance student learning outcomes across global contexts.

Dr. Vasu Muniandy holds a Doctorate in Moral Leadership from Sultan Idris Education University. With over 32 years in education, he has served as a teacher, lecturer, and Head of Department for Strengthening Educational Institutions at the Institut Aminuddin Baki, Ministry of Education, Malaysia where he has contributed significantly to leadership research, module development, and nationwide training for school leaders. Renowned for his expertise in moral leadership, change

management, creativity in education, and leadership challenges, Dr. Vasu continues to be an influential voice in advancing educational leadership in Malaysia.

ORCID

Marcus Pietsch  <http://orcid.org/0000-0002-9836-6793>
 Donnie Adams  <http://orcid.org/0000-0001-7777-5187>
 Vasu Muniandy  <http://orcid.org/0009-0002-2613-515X>

References

- Adams, D., M. Ş. Bellibaş, V. Muniandy, and M. Pietsch. 2025. "The Role of Openness to Experience in Innovating Teaching and Instruction through Leader-Member Exchange and Teacher Creativity." *Thinking Skills and Creativity* 57:101834. <https://doi.org/10.1016/j.tsc.2025.101834>.
- Adams, D., and K. L. Tan. 2022. "Malaysian Education System: Progress, Standards and Aspirations." In *Education in Malaysia: Developments, Reforms and Prospects*, edited by D. Adams, 1–18. Routledge.
- Asparouhov, T. 2005. "Sampling Weights in Latent Variable Modeling." *Structural Equation Modeling* 12 (3): 411–434. https://doi.org/10.1207/s15328007sem1203_4.
- Asparouhov, T. 2013. "Bidirectional Association. Technical appendix retrievable from www.statmodel.com .
- Bakker, A. 2017. "Strategic and Proactive Approaches to Work Engagement." *Organizational Dynamics* 46 (2): 67–75. <https://doi.org/10.1016/j.orgdyn.2017.04.002>.
- Bakker, A. B., and M. Leiter. 2017. "Strategic and Proactive Approaches to Work Engagement." *Organizational Dynamics* 46 (2): 67–75. <https://doi.org/10.1016/j.orgdyn.2017.04.002>.
- Bakker, A. B., and D. Xanthopoulou. 2013. "Creativity and Charisma Among Female Leaders: The Role of Resources and Work Engagement." *International Journal of Human Resource Management* 24 (14): 2760–2779. <https://doi.org/10.1080/09585192.2012.751438>.
- Becker, T. E., G. Atinc, J. A. Breugh, K. D. Carlson, J. R. Edwards, and P. E. Spector. 2016. "Statistical Control in Correlational Studies: 10 Essential Recommendations for Organizational Researchers." *Journal of Organizational Behavior* 37 (2): 157–167. <https://doi.org/10.1002/job.2053>.
- Beghetto, R. A., and J. C. Kaufman. 2017. *Nurturing Creativity in the Classroom*. Cambridge University Press.
- Bellibaş, M. Ş., S. Gümüş, and J. Chen. 2024a. "The Impact of Distributed Leadership on Teacher Commitment: The Mediation Role of Teacher Workload Stress and Teacher Well-Being." *British Educational Research Journal* 50 (2): 814–836. <https://doi.org/10.1002/berj.3944>.
- Bellibaş, M. Ş., F. Ryskulueva, J. Levin, and M. Pietsch. 2024b. "A Safe Space and Leadership Matter for Innovation: Exploring the Role of Psychological Safety in the Relationship Between Transformational Leadership and Innovation Radicalness in Kyrgyz Classrooms." *Educational Management Administration and Leadership* 54 (2): 17411432241264696. <https://doi.org/10.1177/17411432241264696>.
- Bernerth, J. B., M. S. Cole, E. C. Taylor, and H. J. Walker. 2018. "Control Variables in Leadership Research: A Qualitative and Quantitative Review." *Journal of Management* 44 (1): 131–160. <https://doi.org/10.1177/0149206317690586>.
- Bowler, W. M., J. Paul, M. Gavin, T. Joplin, and C. A. Bowler. 2018. "Understanding Trust Transference Between Leaders, Followers and Coworkers: Testing Two Three-Way Interactions." *Journal of Managerial Issues*: 444–462.
- Cohen, W. M., and D. A. Levinthal. 1990. "Absorptive Capacity: A New Perspective on Learning and Innovation." *Administrative Science Quarterly* 35 (1): 128–152. <https://doi.org/10.2307/2393553>.
- Colligan, T. W., and E. M. Higgins. 2006. "Workplace Stress: Etiology and Consequences." *Journal of Workplace Behavioral Health* 21 (2): 89–97. https://doi.org/10.1300/J490v21n02_07.

- Contreras, F., and E. Baykal. 2021. "Effect of the Firm's Absorptive Capacity on the Work Engagement of White-Collar Employees in Istanbul." In *Strategic Outlook in Business and Finance Innovation: Multidimensional Policies for Emerging Economies*, edited by Dinçer, H. and Yüksel, 59–71. Emerald Publishing Limited.
- Cunningham, J. B., and J. MacGregor. 2000. "Trust and the Design of Work: Complementary Constructs in Satisfaction and Performance." *Human Relations* 53 (12): 1575–1591. <https://doi.org/10.1177/00187267005312003>.
- Da'as, R. A., and M. Qadach. 2020. "Examining Organizational Absorptive Capacity Construct: A Validation Study in the School Context." *Leadership and Policy in Schools* 19 (3): 327–345. <https://doi.org/10.1080/15700763.2018.1554155>.
- Dederig, K., and M. Pietsch. 2025. "School Leader Trust and Collective Teacher Innovativeness: On Individual and Organisational ambidexterity's Mediating Role." *Educational Review* 77 (2): 351–380. <https://doi.org/10.1080/00131911.2023.2195593>.
- Demerouti, E., A. B. Bakker, F. Nachreiner, and W. B. Schaufeli. 2001. "The Job Demands-Resources Model of Burnout." *Journal of Applied Psychology* 86 (3): 499–512.
- Dunn, T. J., T. Baguley, and V. Brunsden. 2014. "From α to ω : A Practical Solution to the Pervasive Problem of Internal Consistency Estimation." *British Journal of Psychology* 105 (3): 399–412. <https://doi.org/10.1111/bjop.12046>.
- Erdogan, B., and T. Bauer. 2014. "Leader-Member Exchange (LMX) Theory: The Relational Approach to Leadership." In *The Oxford Handbook of Leadership and Organizations*, edited by D. Day, 407–433. Oxford University Press.
- Erdogan, B., and R. C. Liden. 2002. "Social Exchanges in the Workplace: A Review of Recent Developments and Future Research Directions in Leader-Member Exchange Theory." In *Leadership*, 22–31. Emerald Publishing Limited. <https://doi.org/10.1108/978-1-60752-900-220251004>.
- George, J. M., and J. Zhou. 2001. "When Openness to Experience and Conscientiousness are Related to Creative Behavior: An Interactional Approach." *Journal of Applied Psychology* 86 (3): 513–524. <https://doi.org/10.1037/0021-9010.86.3.513>.
- Graen, G. B., and M. Uhl-Bien. 1995. "Development of Leader-Member Exchange (LMX) Theory of Leadership Over 25 Years: Applying a Multi-Level Multi-Domain Perspective." *Leadership Quarterly* 6 (2): 219–247.
- Granziera, H., and H. N. Perera. 2019. "Relations Among Teachers' Self-Efficacy Beliefs, Engagement, and Work Satisfaction: A Social Cognitive View." *Contemporary Educational Psychology* 58:75–84. <https://doi.org/10.1016/j.cedpsych.2019.02.003>.
- Harmann, H. H. 1960. *Modern Factor Analysis*. University of Chicago Press.
- Harris, A., M. Jones, K. S. L. Cheah, E. Devadason, and D. Adams. 2017. "Exploring Principals' Instructional Leadership Practices in Malaysia: Insights and Implications." *Journal of Educational Administration* 55 (2): 207–221. <https://doi.org/10.1108/JEA-05-2016-0051>.
- Harrison, M. G., R. B. King, and H. Wang. 2023. "Satisfied Teachers Are Good Teachers: The Association Between Teacher Job Satisfaction and Instructional Quality." *British Educational Research Journal* 49 (3): 476–498. <https://doi.org/10.1002/berj.3851>.
- Hayes, A. F. 2018. "Partial, Conditional, and Moderated Moderated Mediation: Quantification, Inference, and Interpretation." *Communication Monographs* 85 (1): 4–40. <https://doi.org/10.1080/03637751.2017.1352100>.
- Hobfoll, S. E., R. J. Johnson, N. Ennis, and A. P. Jackson. 2003. "Resource Loss, Resource Gain, and Emotional Outcomes Among Inner City Women." *Journal of Personality & Social Psychology* 84 (3): 632. <https://doi.org/10.1037/0022-3514.84.3.632>.
- Hoy, W. K., and M. Tschannen-Moran. 2003. "The Conceptualization and Measurement of Faculty Trust in Schools: The Omnibus T-Scale." In *Studies in Leading and Organizing Schools*, edited by W. K. Hoy and C. G. Miskel, 181–208. Greenwich, CT: Information Age.
- Hu, L. T., and P. M. Bentler. 1999. "Cutoff Criteria for Fit Indexes in Covariance Structure Analysis: Conventional Criteria Versus New Alternatives." *Structural Equation Modeling a Multidisciplinary Journal* 6 (1): 1–55. <https://doi.org/10.1080/10705519909540118>.

- Hünermund, P., and B. Louw. 2025. "On the Nuisance of Control Variables in Causal Regression Analysis." *Organizational Research Methods* 28 (1): 138–151. <https://doi.org/10.1177/10944281231219274>.
- Hünermund, P., B. Louw, and M. Rönkkö. 2025. "The Choice of Control Variables in Empirical Management Research: How Causal Diagrams Can Inform the Decision." *Leadership Quarterly* 36 (2), Article 101845. <https://doi.org/10.1016/j.leaqua.2024.101845>.
- Joo, B. K., J. H. Yim, Y. S. Jin, and S. J. Han. 2023. "Empowering Leadership and Employee Creativity: The Mediating Roles of Work Engagement and Knowledge Sharing." *European Journal of Training & Development* 47 (9): 881–899. <https://doi.org/10.1108/EJTD-02-2022-0016>.
- Kline, R. B. 2016. *Principles and Practice of Structural Equation Modeling*. 4th ed. Guilford Press.
- König, J., and B. Pflanzl. 2016. "Is Teacher Knowledge Associated With Performance? On the Relationship Between Teachers' General Pedagogical Knowledge and Instructional Quality." *European Journal of Teacher Education* 39 (4): 419–436. <https://doi.org/10.1080/02619768.2016.1214128>.
- Krauss, S., M. Brunner, M. Kunter, J. Baumert, W. Blum, M. Neubrand, and A. Jordan. 2008. "Pedagogical Content Knowledge and Content Knowledge of Secondary Mathematics Teachers." *Journal of Educational Psychology* 100 (3): 716–725. <https://doi.org/10.1037/0022-0663.100.3.716>.
- Lance, C. E., B. Dawson, D. Birkelbach, and B. J. Hoffman. 2010. "Method Effects, Measurement Error, and Substantive Conclusions." *Organizational Research Methods* 13 (3): 435–455. <https://doi.org/10.1177/1094428109352528>.
- Lau, A. K., and W. Lo. 2015. "Regional Innovation System, Absorptive Capacity and Innovation Performance: An Empirical Study." *Technological Forecasting and Social Change* 92:99–114. <https://doi.org/10.1016/j.techfore.2014.11.005>.
- Lau, D. C., and R. C. Liden. 2008. "Antecedents of Coworker Trust: Leaders' Blessings." *Journal of Applied Psychology* 93 (5): 1130. <https://doi.org/10.1037/0021-9010.93.5.1130>.
- Levin, J., M. Ş. Bellibaş, F. Ryskulueva, and M. Pietsch. 2026. "Inspiring Teacher Creativity Through Leader-Teacher Exchange (LMX): A Job Demands-Resources Perspective." *Social Psychology of Education* 29 (1): 9. <https://doi.org/10.1007/s11218-026-10180-7>.
- Lüdtke, O., H. W. Marsh, A. Robitzsch, U. Trautwein, T. Asparouhov, and B. Muthén. 2008. "The Multilevel Latent Covariate Model: A New, More Reliable Approach to Group-Level Effects in Contextual Studies." *Psychological Methods* 13 (3): 203–229. <https://doi.org/10.1037/a0012869>.
- Mändli, F., and M. Rönkkö. 2025. "To Omit or to Include? Integrating the Frugal and Prolific Perspectives on Control Variable Use." *Organizational Research Methods* 28 (1): 114–137. <https://doi.org/10.1177/10944281231221703>.
- Marsh, H. W., O. Lüdtke, B. Nagengast, A. J. S. Morin, and M. von Davier. 2012. "Why Item Parcels Are (Almost) Never Appropriate: Two Wrongs Do Not Make a Right." *Psychological Methods* 17 (3): 257–284.
- Martin, R., Y. Guillaume, G. Thomas, A. Lee, and O. Epitropaki. 2016. "Leader–Member Exchange (LMX) and Performance: A Meta-Analytic Review." *Personnel Psychology* 69 (1): 67–121. <https://doi.org/10.1111/peps.12100>.
- McDonald, R. P. 1999. *Test Theory: A Unified Treatment*. Lawrence Erlbaum Associates.
- Ministry of Education Malaysia. 2012. *Malaysian Education Blueprint: 2013–2025*.
- Modliba, R., S. B. Fischer, T. Treffers, and I. M. Welp. 2024. "Translating Leader–Member Exchange to Innovative Work Behaviour: The Role of Creative Self-Efficacy and Team Support for Innovation." *Creativity and Innovation Management* 33 (4): 671–684. <https://doi.org/10.1111/caim.12613>.
- Muthén, B., and L. Muthén. 2017. "Mplus." In *Handbook of item response theory*, 507–518. Chapman and Hall/CRC.
- Muthén, B. O., and T. Asparouhov. 2018. "Recent Methods for the Study of Measurement Invariance with Many Groups: Alignment and Random Effects." *Sociological Methods & Research* 47 (4): 637–664. <https://doi.org/10.1177/0049124117701488>.
- Pan, H. L., Y. C. Lin, and C. H. Chung. 2024. "Teacher Collaboration, School Innovativeness and Innovative Teaching in Taiwan: Evidence from TALIS." *International Journal of Educational Research* 127:102383. <https://doi.org/10.1016/j.ijer.2024.102383>.

- Petrowski, K., S. Kliem, C. Albani, A. Hinz, and E. Brähler. 2019. "Norm Values and Psychometric Properties of the Short Version of the Trier Inventory for Chronic Stress (TICS) in a Representative German Sample." *Public Library of Science ONE* 14 (11): e0222277. <https://doi.org/10.1371/journal.pone.0222277>.
- Petrowski, K., G. B. Wintermann, and M. Siepmann. 2012. "Cortisol Response to Repeated Psychosocial Stress." *Applied Psychophysiology and Biofeedback* 37 (2): 103–107.
- Pietsch, M., P. Tulowitzki, and C. Cramer. 2023. "Innovating Teaching and Instruction in Turbulent Times: The Dynamics of Principals' Exploration and Exploitation Activities." *Journal of Educational Change* 24 (3): 549–581. <https://doi.org/10.1007/s10833-022-09458-2>.
- Preacher, K. J., and A. F. Hayes. 2008. "Asymptotic and Resampling Strategies for Assessing and Comparing Indirect Effects in Multiple Mediator Models." *Behavior Research Methods* 40: 879–891. doi:10.3758/BRM.40.3.879.
- Röhl, S., M. Pietsch, and C. Cramer. 2024. "School leaders' Self-Efficacy and Its Impact on Innovation: Findings of a Repeated Measurement Study." *Educational Management Administration and Leadership* 52 (6): 1477–1496. <https://doi.org/10.1177/17411432221132482>.
- Schaufeli, W. B., M. Salanova, A. B. Bakker, and V. Gonzales-Roma. 2002. "The Measurement of Engagement and Burnout: A Two Sample Confirmatory Factor Analytic Approach." *Journal of Happiness Studies* 3 (1): 71–92. <https://doi.org/10.1023/A:1015630930326>.
- Schaufeli, W. B., A. Shimazu, J. Hakanen, M. Salanova, and H. De Witte. 2019. "An Ultra-Short Measure for Work Engagement: The UWES-3 Validation Across Five Countries." *European Journal of Psychological Assessment* 35 (4): 577–591. <https://doi.org/10.1027/1015-5759/a000430>.
- Schmitz, G., and R. Schwarzer. 2002. "Individuelle Und Kollektive Selbstwirksamkeitserwartung Von Lehrern." In *Selbstwirksamkeit Und Motivationsprozesse In Bildungsinstitutionen*, edited by Jerusalem M and Hopf D, 192–214. Weinheim: Beltz.
- Schulz, P., W. Schlotz, and P. Becker. 2004. *Trierer Inventar Zum Chronischen Stress (TICS). [Trier Inventory For Chronic Stress (TICS)]*. Göttingen, Germany: Hogrefe.
- Schweisfurth, T. G., and C. Raasch. 2018. "Absorptive Capacity for Need Knowledge: Antecedents and Effects for Employee Innovativeness." *Research Policy* 47 (4): 687–699. <https://doi.org/10.1016/j.respol.2018.01.017>.
- Sherony, K. M., and S. G. Green. 2002. "Coworker Exchange: Relationships Between Coworkers, Leader-Member Exchange, and Work Attitudes." *Journal of Applied Psychology* 87 (3): 542–548. <https://doi.org/10.1037/0021-9010.87.3.542>.
- Shi, D., and A. Maydeu-Olivares. 2020. "The Effect of Estimation Methods on SEM Fit Indices." *Educational and Psychological Measurement* 80 (3): 421–445. <https://doi.org/10.1177/0013164419885164>.
- Shulman, L. S. 1986. "Those Who Understand: Knowledge Growth in Teaching." *Educational Researcher* 15 (2): 4–14. <https://doi.org/10.3102/0013189X015002004>.
- Skaalvik, E. M., and S. Skaalvik. 2014. "Teacher Self-Efficacy and Perceived Autonomy: Relations with Teacher Engagement, Job Satisfaction, and Emotional Exhaustion." *Psychological Reports* 114 (1): 68–77. <https://doi.org/10.2466/14.02.PR0.114k14w0>.
- Tan, H. H., and A. K. Lim. 2009. "Trust in Coworkers and Trust in Organizations." *The Journal of Psychology* 143 (1): 45–66. <https://doi.org/10.3200/JRLP.143.1.45-66>.
- Tan, H. H., and A. K. Lim. 2009. "Trust in Coworkers and Trust in Organizations." *The Journal of Psychology* 143 (1): 45–66.
- Tian, A. W., and C. Soo. 2018. "Enriching Individual Absorptive Capacity." *Personnel Review* 47 (5): 1116–1132.ress. <https://doi.org/10.1108/PR-04-2017-0110>.
- Tschannen-Moran, M., and A. W. Hoy. 2001. "Teacher Efficacy: Capturing an Elusive Construct." *Teaching & Teacher Education* 17 (7): 783–805. [https://doi.org/10.1016/S0742-051X\(01\)00036-1](https://doi.org/10.1016/S0742-051X(01)00036-1).
- Tummers, L. G., and A. B. Bakker. 2021. "Leadership and Job Demands-Resources Theory: A Systematic Review." *Frontiers in Psychology* 12:722080. <https://doi.org/10.3389/fpsyg.2021.722080>.
- Ugwuanyi, C. S., M. Ş. Bellibaş, and M. Pietsch. 2025. "Leader-Member Exchange and Teacher Creativity in Nigerian Schools the Mediating Role of Paradox Mindset and Individual

- Ambidexterity." *Leadership and Policy in Schools*: 1–21. <https://doi.org/10.1080/15700763.2025.2539804>.
- Witthöft, J., D. Adams, B. Aydin, V. Muniandy, and M. Pietsch. 2025. "Microfoundations of Open Innovation in Schools: Overcoming teachers' Not-Invented-Here Syndrome with Transformational Leadership and Leader-Member-Exchange." *School Leadership and Management* 46 (1): 131–155. <https://doi.org/10.1080/13632434.2025.2580641>.
- Xiong, F., S. Li, W. Zhang, and N. Xu. 2024. "Individuals' Capacity to Innovate: A Literature Review of Individual Absorptive Capacity." *Innovation* 27 (4): 1–21. <https://doi.org/10.1080/14479338.2024.2363255>.
- Zacher, H., and G. Winter. 2011. "Eldercare Demands, Strain, and Work Engagement: The Moderating Role of Perceived Organizational Support." *Journal of Vocational Behavior* 79 (3): 667–680.
- Zahra, S. A., and G. George. 2002. "Absorptive Capacity: A Review, Reconceptualization, and Extension." *Academy of Management Review* 27 (2): 185–203. <https://doi.org/10.2307/4134351>.
- Zhou, J., and J. M. George. 2001. "When Job Dissatisfaction Leads to Creativity: Encouraging the Expression of Voice." *Academy of Management Journal* 44 (4): 682–696. <https://doi.org/10.2307/3069410>.
- Zhou, J., and J. M. George. 2003. "Awakening Employee Creativity: The Role of Leader Emotional Intelligence." *Leadership Quarterly* 14 (4–5): 545–568. [https://doi.org/10.1016/S1048-9843\(03\)00051-1](https://doi.org/10.1016/S1048-9843(03)00051-1).