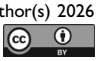
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Temporary shocks, stable beliefs: A three-wave longitudinal study of school leaders' self-efficacy and work engagement across the COVID-19 pandemic (2019–2022)

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Abstract

The COVID-19 pandemic represented an environmental jolt that challenged school leaders' functioning under conditions of uncertainty and resource constraints, yet longitudinal evidence on how leaders' psychological resources evolve through and beyond such shocks remains scarce. Grounded in Conservation of Resources (COR) theory, this study examines the trajectories and dynamic interplay of school leaders' self-efficacy (SE) and work engagement (WE). Using a three-wave panel study of German school leaders (2019–2022; $N = 405$), we applied multivariate latent growth curve modeling to examine changes and dynamics in these two resources across the pandemic. Findings show that WE declined significantly, whereas SE remained stable. SE and WE were temporarily coupled during the acute phase of the pandemic but decoupled thereafter. These findings advance leadership theory by demonstrating how cognitive and motivational resources develop differently during systemic crises.

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school leaders, self-efficacy, work engagement, COVID-19, conservation of resources, longitudinal research, latent growth curve modeling

Introduction

The COVID-19 pandemic triggered one of the most profound disruptions of schooling worldwide in recent history. Rapid policy changes, shifting modes of emergency teaching, and unprecedented coordination and communication demands challenged educational systems and placed substantial pressure on school leaders (D'Souza et al., 2023). Unlike routine periods of organizational change, the pandemic confronted school leaders with a prolonged environmental disruption in which established routines became insufficient, and decisions had to be made under conditions of uncertainty, limited information, and rapidly changing demands (Striepe and Kafa, 2025), thereby constituting a so-called environmental jolt (Hitt et al., 2021).

In situations such as these, where stabilizing organizational resources are weakened or no longer sufficient to meet emerging demands, personal resources may become particularly critical for maintaining effective functioning and adaptive responses (Bakker and Demerouti, 2017; Hobfoll, 2011). In this regard, theory posits that self-efficacy constitutes an important personal resource within the motivational process described by the Job Demands–Resources (JD-R) model, in which personal resources and work engagement jointly contribute to favorable individual and organizational outcomes (Bakker and Demerouti, 2017). However, recent longitudinal studies suggest that the relationship between self-efficacy and work engagement may be reciprocal rather than purely unidirectional. Evidence from research among teachers indicates that self-efficacy and work engagement can mutually reinforce each other over time (Burić et al., 2022; Simbula et al., 2011). Whether these reciprocal dynamics also apply to school leaders, who operate under distinct leadership demands and responsibilities, remains largely unexplored.

Drawing on a Conservation of Resources (COR) perspective (Hobfoll, 1989, 2002, 2011), the present study thus examines how these two psychological resources evolve among school leaders exposed to systemic disruption. In essence, COR theory suggests that resources develop in dynamic cycles, with resource losses generally exerting stronger effects than equivalent gains (i.e., primacy of resource loss). Accordingly, contexts characterized by uncertainty and diminished resource availability may place individuals at risk of resource loss spirals, whereas resource preservation may support adaptive functioning (Hobfoll et al., 2018). Specifically, we focus on innovation-related self-efficacy (I-SE), a domain-specific efficacy belief reflecting leaders' confidence in developing and implementing novel responses when established routines become insufficient (Röhl et al., 2024). Complementing this personal resource, work engagement (WE) captures school leaders' motivational energy and involvement in their leadership tasks (Schaufeli and Bakker, 2004).

To investigate how school leaders' psychological resources changed over the course of the COVID-19 pandemic, we draw on a rare three-wave representative longitudinal dataset of German school leaders collected before, during, and after the pandemic (2019, 2021, and 2022). Unlike most studies examining pandemic-related consequences, which rely on cross-sectional designs or data collected only during or after the crisis (e.g., Suter et al., 2024), this unique design enables us to distinguish temporary crisis-related fluctuations from more enduring patterns of stability and change in leaders' psychological resources.

Theoretical framework: Resource dynamics in school leadership

Conceptualizing crisis: Environmental jolts and threat rigidity

From a public administration perspective, the COVID-19 pandemic represents an environmental jolt—a sudden, disruptive, and unprecedented external event that fundamentally destabilizes established organizational routines and governance structures (Meyer, 1982; Sine and David, 2003). Unlike routine organizational challenges, environmental jolts disrupt predictability, render established procedures insufficient, and require organizations to operate under conditions of high uncertainty and rapidly changing demands (Christianson et al., 2009). For schools and school leaders, this created a fundamental paradox: they were expected to ensure the continuity and reliability of educational provision while simultaneously developing adaptive responses to rapidly changing and unpredictable circumstances (Pietsch et al., 2023; Yurkofsky and Peurach, 2023).

Schools were particularly affected because they operate within highly regulated public governance systems that rely on formal procedures, hierarchical coordination, and stable accountability structures (Ansell et al., 2021). During the pandemic, school closures, emergency remote education, and rapidly changing governmental regulations substantially disrupted these established governance mechanisms (Huber and Helm, 2020). Consequently, school leaders were required to make rapid decisions under conditions of incomplete information while simultaneously managing heightened uncertainty, increased workload, and the diverse needs of teachers, students, and families (Pietsch et al., 2023).

Based on established crisis literature, however, severe external threats would be expected to trigger a threat-rigidity response (Sarkar and Osiyevskyy, 2018; Staw et al., 1981), characterized by increased centralization, reduced information processing, and reliance on established routines. At the same time, the pandemic frequently required school leaders to complement such responses with adaptive and innovative forms of action. Rather than relying solely on established procedures, they had to develop locally responsive solutions, coordinate across organizational boundaries, and continuously adapt pedagogical and organizational practices to rapidly changing circumstances (Brown et al., 2023; Harris and Jones, 2020). Thus, the pandemic placed school leaders in a persistent tension between maintaining stability and continuity on the one hand and exercising flexibility, innovation, and adaptive capacity on the other.

This tension reflects the specific challenges of leadership in extreme contexts, where uncertainty, threat, and rapidly changing demands fundamentally alter the conditions under which leaders operate (Hannah et al., 2009). Unlike routine leadership situations, extreme contexts require leaders to make timely decisions despite incomplete information, adapt continuously to changing circumstances, and maintain organizational functioning while facing heightened personal and organizational risks (Hadley et al., 2011). Under such conditions, leaders' ability to sustain adaptive functioning depends not only on organizational structures but also on the psychological resources available to them (Marsh et al., 2023).

Psychological resources in crises: A conservation of resources perspective

To understand how school leaders navigate systemic disruptions such as the COVID-19 pandemic, this study draws on COR theory as its primary conceptual framework (Hobfoll, 1989, 2002, 2011). COR theory proposes that individuals are motivated to obtain, retain, protect, and invest valued resources because these resources enable them to cope with environmental demands and pursue personal and professional goals. Stress occurs when resources are threatened, lost, or insufficiently

replenished, whereas resource gains can generate positive spirals that enhance adaptation and functioning (Hobfoll, 2002).

Within this perspective, self-efficacy (SE) and WE are regarded as important psychological resources that shape occupational functioning, resilience, and adaptive performance (Bakker and Demerouti, 2017). Although conceptually distinct, these resources may operate differently over time. Self-efficacy refers to individuals' beliefs in their capability to organize and execute actions required to achieve desired outcomes (Bandura, 1997). These beliefs influence how individuals interpret challenging situations, regulate effort, persist in the face of obstacles, and recover from setbacks (Bandura, 1997), thereby representing a cognitive resource for adaptive functioning. Work engagement, in contrast, represents a positive and fulfilling work-related state characterized by vigor, dedication, and absorption (Schaufeli et al., 2002). As a motivational resource, work engagement reflects the energetic and motivational investment individuals bring to their work and their willingness to sustain effort in the pursuit of work-related goals.

Although conceptually distinct, SE and WE are closely interconnected. Self-efficacy shapes individuals' willingness to invest effort, pursue challenging goals, and actively engage with demanding tasks (Bakker and Demerouti, 2017; Xanthopoulou et al., 2009). At the same time, successful and engaging work experiences provide mastery experiences that reinforce efficacy beliefs (Bandura, 1997). Within the JD-R model, cognitive resources such as SE are conceptualized as antecedents of motivational resources such as work engagement, which in turn contribute to positive work outcomes (Bakker and Demerouti, 2017), i. e., creativity and innovation (Levin et al., 2026; Pietsch et al., 2026). At the same time, cognitive and motivational resources may reinforce each other through reciprocal gain processes over time, whereby stronger efficacy beliefs facilitate engagement and engagement-related experiences further strengthen perceptions of competence (Luthans et al., 2006; Xanthopoulou et al., 2009).

Importantly, while work engagement represents a relatively broad and general motivational resource that reflects individuals' energetic investment, dedication, and persistence across work contexts (Schaufeli et al., 2002), self-efficacy is inherently domain-specific and reflects individuals' beliefs regarding their capability to successfully perform particular tasks or cope with specific challenges (Bandura, 1997). Accordingly, self-efficacy can take different forms depending on the demands individuals face. In contexts characterized by change, uncertainty, and the need to develop new solutions, I-SE represents a particularly relevant form of this personal resource because it reflects individuals' confidence in their ability to generate, implement, and sustain novel approaches (Gong et al., 2009; Tierney and Farmer, 2002).

When applied to school leadership, this construct constitutes a specific form of leader action self-efficacy (Ugwuanyi and Pietsch, 2026), reflecting "*leaders' beliefs that they have the capability to enact leadership and create effects*" (Hannah et al., 2012: 148). In this regard, empirical findings show that I-SE drives innovation in schools under conditions of high uncertainty (Röhl et al., 2024), whereas in more stable contexts, it significantly shapes school leaders' learning-oriented leadership behavior, namely leadership for learning (Ugwuanyi and Pietsch, 2026). Furthermore, empirical research indicates that I-SE is fundamentally malleable. In particular, mastery experiences, namely experiences of success and failure, along with verbal encouragement and support from members of the school community, such as teachers and other leaders, significantly shape school leaders' I-SE (Syvertsen et al., 2025; Ugwuanyi and Pietsch, 2026). Nonetheless, longitudinal investigations examining these dynamics remain scarce, and the specific role of WE in this process remains largely unexplored.

The distinction between I-SE and WE is particularly relevant in the context of the COVID-19 pandemic. While work engagement captures school leaders' general motivational state, I-SE

reflects a more specific capability belief that becomes especially salient when established routines and procedures no longer provide sufficient guidance (Röhl et al., 2024; Sun et al., 2024). During the pandemic, school leaders were required to redesign instructional practices, develop new forms of communication and coordination, and create locally responsive solutions under conditions of high uncertainty (Brown et al., 2023; Harris and Jones, 2020). In such circumstances, confidence in one's ability to innovate may have functioned as an important personal resource that enabled leaders to maintain agency, invest effort proactively, and respond adaptively to emerging challenges.

In this regard, COR theory provides two principles that are particularly relevant for understanding the inherent resource dynamics. First, the primacy of resource loss principle suggests that resource losses have stronger psychological consequences than equivalent resource gains (Hobfoll, 2002). The sudden disruption of established routines, predictability, and available time during school closures therefore had the potential to undermine school leaders' work engagement. Second, the resource investment principle proposes that individuals must invest existing resources to prevent further losses and to generate future gains. In this regard, I-SE may function as an important personal resource that enables leaders to maintain agency, interpret uncertain situations as manageable, and mobilize adaptive responses. In contrast, work engagement represents a more dynamic energetic resource that is expected to be more directly influenced by fluctuations in external demands.

This distinction is particularly relevant for understanding school leadership during the pandemic. As outlined above, the environmental jolt created a tension between the need to maintain stability and continuity and the need to develop flexible and innovative responses when established routines no longer work. Although school leaders in Germany traditionally operate within a comparatively bureaucratic and hierarchical governance structure with limited formal autonomy (Dahle and Wermke, 2024; Mintrop, 2015), the crisis increased the need for rapid, locally responsive decision-making (Röhl et al., 2024). Under these conditions, I-SE may have served as a personal resource that supported leaders' confidence in developing and implementing novel solutions, maintaining agency, and adapting their practices despite uncertainty and disrupted organizational routines. In contrast, work engagement may have been more vulnerable to sustained increases in workload, uncertainty, and emotional pressures because it reflects a broader motivational and energetic state.

Literature review and hypotheses

Taken together, from a COR theory perspective, the following patterns can be expected to emerge. First, innovation-related self-efficacy and work engagement should be positively associated because both represent valuable psychological resources that support adaptive functioning. Second, these resources may influence each other over time through reciprocal gain processes, whereby confidence in one's capabilities facilitates engagement and successful engagement-related experiences reinforce efficacy beliefs. Third, work engagement may be particularly susceptible to decline under prolonged crisis-related demands because it reflects a more dynamic, energetic, and motivational state that is directly affected by changing work conditions. Fourth, innovation-related self-efficacy may demonstrate greater temporal stability because it reflects accumulated beliefs about one's capability to cope with uncertainty, solve novel problems, and implement change, which are less immediately affected by short-term fluctuations in environmental demands. The following section examines these theoretically derived hypotheses in greater detail.

H1: The association between leaders' SE and WE is positive.

According to Social Cognitive Theory (Bandura, 1997) and the JD-R model (Bakker and Demerouti, 2017), self-efficacy represents an important personal resource that facilitates motivation, persistence, and proactive behavior. Accordingly, individuals who believe in their ability to successfully cope with challenges are more likely to invest effort and remain engaged in their work. Consistent with this reasoning, empirical research across occupational contexts has consistently demonstrated a positive association between self-efficacy and work engagement (Mazzetti et al., 2023; Xanthopoulou et al., 2009). Research among school leaders further indicates that leadership-related efficacy beliefs are positively linked to work engagement (Anselmus Dami et al., 2022). Thus, we expect innovation-related self-efficacy to be positively associated with leaders' work engagement.

H2: Leader SE and WE interact over time.

While cross-sectional research consistently shows a positive association between SE and WE, recent longitudinal studies suggest that this relationship may reflect dynamic reciprocal processes rather than a purely unidirectional effect. From a social cognitive perspective, self-efficacy may foster engagement by increasing persistence and goal-directed effort, whereas engagement may provide mastery experiences and positive affective states that reinforce efficacy beliefs (Bandura, 1997). Empirical studies using longitudinal approaches have provided evidence for reciprocal relationships between self-efficacy and work engagement among teachers (Burić et al., 2022; Salanova et al., 2011). Whether such within-person dynamics also characterize school leaders remains unknown.

H3: Work engagement decreases during the COVID-19 pandemic and stays lower afterwards.

According to the JD-R model, sustained increases in job demands combined with reduced access to organizational resources can initiate a motivational decline and undermine work engagement (Bakker and Demerouti, 2017). The COVID-19 pandemic substantially intensified school leaders' demands through increased workload, uncertainty, emotional strain, and continuous adaptation requirements (Ansell et al., 2021; Harris and Jones, 2020). Previous longitudinal research among educators documented declines in well-being and engagement during the pandemic (Katsarou et al., 2023; Zaleski, 2022). Therefore, we expect school leaders' work engagement to decline during the pandemic and not fully recover immediately afterwards.

H4: SE is not affected by a stressful period or stressful life event, i.e., COVID-19.

Self-efficacy represents a central personal resource that develops through accumulated mastery experiences and successful adaptation to challenges (Bandura, 1997). Although efficacy beliefs are malleable, they do not necessarily decline in response to stressful events, as challenging situations can also provide opportunities for learning and competence development (Gist and Mitchell, 1992; Hobfoll, 2002). This may be particularly relevant for innovation-related self-efficacy, as the COVID-19 pandemic required school leaders to develop and implement novel solutions under unprecedented conditions (Röhl et al., 2024). Successful adaptation to these demands may have generated mastery experiences that helped preserve leaders' confidence in their innovative capabilities. Consistent with longitudinal findings among teachers showing stable or even increasing self-

efficacy during the pandemic (Weißenfels et al., 2022), we expect innovation-related self-efficacy among school leaders to remain stable over time.

H5: A decrease in WE as a consequence of COVID-19 leads to a decrease in SE after the pandemic.

Although self-efficacy is traditionally considered a driver of work engagement (Bandura, 1997), recent longitudinal research suggests that the relationship between these two personal resources may also operate in the opposite direction. Studies using advanced longitudinal approaches have shown that work engagement can predict subsequent changes in self-efficacy, indicating that experiences of energy, dedication, and involvement at work may contribute to the development and maintenance of efficacy beliefs (Burić et al., 2022; Granziera and Perera, 2019).

From a Conservation of Resources perspective, losses in motivational resources may therefore initiate further resource losses, as reduced engagement limits opportunities for mastery experiences and positive affective states that sustain self-efficacy (Hobfoll, 1989, 2002). Applied to the COVID-19 pandemic, increases in demands and uncertainty may have undermined school leaders' work engagement by reducing vigor, dedication, and absorption in their leadership tasks. Such declines in engagement may subsequently weaken innovation-related self-efficacy, as less engaged leaders may have fewer opportunities to experience successful problem solving and perceive themselves as capable agents of change. Accordingly, we expect that reductions in work engagement during the pandemic are followed by decreases in innovation-related self-efficacy.

Methods

To examine the proposed relationships between school leaders' self-efficacy and work engagement over time, a longitudinal research design was employed. The following sections describe the study context, sample and procedure, measures, and the analytical strategy used to investigate the trajectories and interrelations of both constructs.

Context, participants and procedure

This study draws on longitudinal data from the *Leadership in German Schools* (LineS) project, a longitudinal research initiative examining a random sample of school leaders in Germany across multiple measurement waves. Participant recruitment was conducted by the survey research institute *Forsa*, which maintains a nationwide panel based on multi-topic daily telephone interviews with approximately 1000 randomly selected individuals across Germany. Through a screening procedure, a cohort of school leaders from general education schools, including both public and private schools, was identified in 2019 and subsequently surveyed longitudinally using online questionnaires.

During the baseline assessment conducted between August and November 2019, 650 school leaders were randomly sampled from the population of school leaders in general education schools in Germany, of whom $N = 405$ participated, yielding a response rate of 62%. Participation was voluntary, and respondents were informed about the voluntary nature of the study, data protection regulations, and confidentiality procedures prior to participation.

The longitudinal design comprises three primary measurement waves: the baseline assessment in autumn 2019 (t_0), a second survey in spring 2021 (t_1), and a third survey in 2022(t_2). An additional ad hoc survey was administered in spring 2020 during the initial nationwide school closures in

Germany ($t_{0.1}$; Röhl et al., 2024). Because this supplementary assessment took place within the same school year as the baseline survey and included only a subset of the original scales, it is not fully comparable with the primary measurement waves and was therefore excluded from the present analyses.

The three primary measurement waves capture distinct organizational conditions before, during, and following the acute phase of the COVID-19 pandemic. The first wave in autumn 2019 (t_0) established the pre-pandemic baseline, when schools operated under regular conditions characterized by in-person instruction, established administrative routines, and standard organizational structures. Following the outbreak of the pandemic in March 2020, all schools across Germany were closed within a short period and subsequently reopened gradually, initially through alternating student cohorts. A second nationwide lockdown followed, with schools again closed from mid-December 2020 until early spring 2021. During these extended periods of school closure and restricted operation, instructional delivery, staff collaboration, and administrative processes shifted substantially toward remote formats, requiring school leaders and teachers to organize distance education and staff coordination under rapidly changing conditions and with limited pre-existing digital infrastructures.

The second survey wave in spring 2021 (t_1) therefore captured school leadership during a period of sustained crisis-related demands and considerable organizational uncertainty. School leaders had to coordinate alternating student cohorts, remote staff collaboration, testing and hygiene procedures, and frequently changing state-level infection-control regulations. The third wave in 2022 (t_2) reflected a later phase characterized by a return to more stable organizational routines and predominantly continuous in-person instruction. During this phase, leadership priorities increasingly shifted from immediate crisis management toward addressing learning gaps, supporting staff and student well-being, and resuming longer-term school improvement under the changed organizational conditions created by the pandemic.

The sample at t_0 included leaders from different school types and educational sectors, including primary schools (51.9%), lower secondary schools (e.g., Hauptschule: 3.0%; Realschule: 9.1%), upper secondary schools (e.g., Gymnasium: 14.8%), comprehensive schools (11.3%), and special education schools (6.4%). The majority of school leaders worked in public schools (91.5%), while 8.5% were employed in private schools. 19.0% of the school leaders reported working in rural areas or villages (<3000 inhabitants), 33.3% in small towns (3000–15,000 inhabitants), 29.9% in towns (15,000–100,000 inhabitants), 13.1% in cities (100,000–1,000,000 inhabitants), and 4.4% in metropolitan cities (>1,000,000 inhabitants). Regarding demographic characteristics, 55.8% of school leaders were female, and 43.7% were male (0.5% of the information was missing). The mean age was 53.54 years (SD = 7.72), and participants had, on average, 15.11 years (SD = 7.25) of teaching experience before entering school leadership and 9.94 years (SD = 7.31) of leadership experience at the time of the first measurement.

Measures

The SE of school leaders was assessed at three time points, using four items adapted from Schmitz and Schwarzer (2002) following Röhl et al. (2024). These items aim to assess the self-efficacy of school leaders regarding innovation. An example item is: "I know that I can motivate teachers at my school to participate in innovative projects." All items were answered on a 4-point scale, with responses ranging from 1 (do not agree at all) to 4 (totally agree). In our sample, internal consistency was satisfactory at each time point, with omega values of 0.81, 0.82, and 0.88 for t_0, t_1, and t_2, respectively.

The WE of school leaders was also assessed at three time points, using the Utrecht Work Engagement Scale (UWES) three-item ultra-short form introduced by Schaufeli et al. (2019). The scale has one item for each to measure vigor, dedication, and absorption. An example item (absorption) is: "I am immersed in my work." Answered also using a 4-point scale, the scale scores demonstrated satisfactory internal consistency at each time point, with omega values of .64, .76, and .86 for t_0, t_1, and t_2, respectively.

Attrition

We have computed SE and WE observed scores for each time point by taking the item averages. For SE, there were 393, 100, and 55 available scores at t_0, t_1, and t_2, respectively, resulting in missing data rates of 3.0%, 75.3%, and 86.4%. Similarly, for WE, there were 389, 98, and 57 available scores, corresponding to missing data rates of 3.9%, 75.8%, and 85.9% at t_0, t_1, and t_2, respectively. A notable attrition over time was observed. Moreover, 131 school leaders (32.5%) were aged 60 years or older at t_0, suggesting that a substantial number may have retired during the observation period and consequently were no longer included by *Forsa* in the sample at t_1, and t_2. Nonetheless, explanatory *t*-tests comparing t_0 scores between participants who withdrew and those with complete data indicated no significant differences. Specifically, when comparing SE initial scores for those who withdrew versus those who stayed, the independent *t*-tests resulted in *P*-values of .913 and .905 at t_1 and t_2, respectively, with the SE score difference being lower than 0.01 at t_0. Similarly, when comparing WE initial scores for those who withdrew versus those who stayed, the *P*-values were .982 and .243 at t_1 and t_2, respectively, with the WE score difference being lower than 0.09 at t_0.

Data analytic approach

Our analytical approach includes five sequential steps, as we started with longitudinal measurement invariance (LMI) before we compute correlations, and run separate latent growth models (LGM), a multivariate LGM (MLGM) to study the relation of growth parameters, and finally a multivariate regression model to study the change in SE after the COVID-19 pandemic. We utilized M*plus* software's (Version 8.11; Muthén and Muthén, 2025) full information maximum likelihood (FIML) estimation to address missing data.

LMI is essential for ensuring that a construct is measured consistently across different time points, which is important for accurately interpreting changes or stability in latent variables. Without invariance, differences observed over time may arise from changes in measurement properties, rather than actual changes in the construct (Vandenberg and Lance, 2000). LMI analyses were conducted in M*plus*, specifically by declaring maximum likelihood as the estimator and including configural, metric, and scalar arguments in the model section.

Following LMI, we computed observed scores for each time point for SE and WE. Based on these observed scores, we computed correlation coefficients using both complete cases and FIML. To further understand the associations between the observed SE and WE scores, we conducted separate LGMs to model the overall growth trajectories. Specifically, by fixing the measurement time points to 0, 1, and 2 for t_0, t_1, and t_2, respectively, we modeled linear change over time.

We completed our analyses with two multivariate models to study the growth associations of SE and WE. First, often embedded within structural equation modeling or multilevel frameworks (Geiser et al., 2013; McNeish, 2025), MLGMs can extend basic LGMs by modeling multiple outcomes simultaneously, capturing both within- and between-person variability in change processes (Duncan and Duncan, 2004; Leite, 2007). We specifically followed the MLGM steps provided by

Bollen and Curran (2006) to study developmental trajectories and interrelationships between SE and WE. Second, to complement MLGM results, we conducted a multivariate regression model to study whether the WE score change can predict the change in SE after COVID-19. Specifically, we computed the SE gain scores from t_0 to t_1 and t_1 to t_2 (i.e., SE_1–SE_0 and SE_2–SE_1) and treated them as two separate dependent variables to be predicted by WE change scores from t_0 to t_1 (i.e., WE_1–WE_0) in M*plus*. We activated FIML with standard errors robust to non-normality (i.e., Maximum likelihood with robust standard errors (MLR); *estimator = MLR*) and requested standardized solutions (i.e., STDYX) along with 95% confidence intervals (CI) using the *cinterval* command.

Results

Preliminary analyses

Confirmatory factor analyses for SE at t_0 resulted in a Comparative Fit Index (CFI) of 0.980, Tucker-Lewis Index (TLI) of 0.941, Root Mean Square Error of Approximation (RMSEA) of 0.111, and Standardized Root Mean Square Residual (SRMR) of 0.023, with standardized factor loadings larger than 0.64, indicating an acceptable model-data fit (McNeish, 2025). LMI results showed that the SE scale showed scalar invariance across t_0–t_2. Specifically, CFI values were 0.962, 0.965, 0.966, TLI values were 0.950, 0.960, 0.964, RMSEA values were 0.040, 0.036, 0.034, and SRMR values were 0.064, 0.078, 0.074, respectively, for configural, scalar, and metric invariance models; with all chi-square difference tests among invariance models resulting in *P*-values larger than .05. For the WE scale, the standardized factor loadings at t_0 were 0.60, 0.67, and 0.57 for the first, second, and third items, respectively. LMI results showed that WE also had scalar invariance, CFI values were 0.922, 0.909, 0.913, TLI values were 0.883, 0.883, 0.902, RMSEA values were 0.057, 0.057, 0.052, and SRMR values were 0.071, 0.111, 0.112, respectively, for configural, scalar, and metric invariance models; with all chi-square difference tests among invariance models resulting in *P*-values larger than .05.

Table 1 reports correlation coefficients for the SE and WE scores across time, in which values below the diagonal were computed with pairwise complete data, whereas values above the diagonal were computed with M*plus'* FIML using 402 cases. The lowest correlation coefficient with the pairwise complete data was computed for the SE_0 and WE_0 ($r = 0.328$), whereas the largest was computed for the SE_1 and SE_2 ($r = 0.743$). The correlation coefficients with FIML were negligibly weaker; the lowest was computed for SE_0 and WE_3 ($r = 0.309$), whereas the largest was computed for WE_1 and WE_2 ($r = 0.685$). Nevertheless, all correlation coefficients were moderately positive and statistically significant, with *P*-values lower than .05.

LGM

Table 2 reports univariate and multivariate LGM results. Linear LGM for the SE scores resulted in good fit with RMSEA = 0.00, CFI = 1.00, TLI = 1.00, and SRMR = 0.01, the model predicted initial SE scores as 3.19 ($P < .05$) with a statistically insignificant negative slope of −0.04 and a covariance between intercept and slope of 0.02, indicating that the participants' SE scores remained roughly the same over time.

The first linear LGM for the WE scores yielded a poor fit, with RMSEA = 0.15, CFI = 0.89, TLI = 0.67, and SRMR = 0.06. The second linear LGM set residual variances to be equal across time to simplify the model, and this modification improved fit with RMSEA = 0.08, CFI = 0.92, TLI = 0.92, and SRMR = 0.10. This model predicted initial WE scores as 3.11 ($P < .05$) with a statistically

Table 1. Correlations for SE and WE average scores across time.

	1	2	3	4	5	6
1. SE_0	–	0.515	0.592	0.352	0.368	0.309
2. SE_1	0.615	–	0.674	0.485	0.570	0.554
3. SE_2	0.654	0.743	–	0.328	0.432	0.459
4. WE_0	0.328	0.566	0.423	–	0.516	0.563
5. WE_1	0.498	0.624	0.534	0.568	–	0.685
6. WE_2	0.482	0.635	0.576	0.568	0.736	–

significant negative slope of −0.16 ($P < .05$) and a covariance between intercept and slope of 0.05 ($P < .05$), indicating that the participants' WE scores decreased slightly over time, and participants with relatively higher initial scores showed a relatively steeper decrease.

The MLGM restricted residual variances to be equal across time for SE and WE separately, along with the paired correlations for the residuals as suggested by Bollen and Curran (2006). The model yielded an acceptable fit, with RMSEA = 0.05, CFI = 0.97, TLI = 0.95, and SRMR = 0.09, and roughly identical results with the univariate LGMs for the growth parameters. However, MLGM revealed no associations between the intercepts and slopes for the SE and WE, except for the significant covariance between the intercepts of 0.08 ($P < .05$). As reported in Table 1, the FIML zero-order correlation between SE_0 and WE_0 was 0.352, indicating a positive linear association for the initial scores.

Multivariate regression

As reported in Table 3, our multivariate regression model resulted in statistically insignificant intercept estimates of $b = 0.017$ ($P = .739$, 95% CI: −0.082 to 0.115) and $b = -0.067$ ($P = .307$, 95% CI: −0.196 to 0.062) for the first and second gain scores (i.e., SE_1–SE_0 and SE_2–SE_1), respectively. These results indicate that, for the participants with no change in WE (i.e.,$WE_1 - WE_0 = 0$), SE scores also remained relatively stable. The covariance and correlation between the gain scores were negative and significant, with values of −0.080 ($P < .001$, 95% CI: −0.124 to −0.036) and −0.442 ($P < .001$, 95% CI: −0.616 to −0.268), indicating a linear negative relationship.

A more detailed, case-by-case examination of the data revealed that the SE of those school leaders whose SE had declined during the pandemic returned to its original level afterward (Figure 1(a) and 1(b)). Conversely, among those whose SE had increased substantially during the COVID-19 pandemic, SE decreased again after the pandemic and stabilized near its initial level. In essence, this suggests that during the pandemic in 2021, school leaders perceived themselves as either more or less self-efficacious than before the pandemic. Nevertheless, these differences did not result in lasting changes in their innovation-related self-efficacy over time.

WE change score predicted the change in SE from t_0 to t_1 with an R^2 value of 0.04; the regression coefficient for the WE change score was positive, with the value of $b = 0.177$ ($P = .037$, 95% CI: 0.010–0.343, β=0.200). Considering the results of the LGM, this indicates that, on average, there is no decline in SE between t_0 and t_1. However, individuals who do exhibit change in SE also tend to show corresponding change in WE, and vice versa. In contrast, the WE change score failed to predict the change in SE from t_2 to t_1 with an R^2 value of 0.02; the regression coefficient for the WE change score was negative but insignificant, with the value of $b = -0.031$ ($P = .724$, 95% CI: −0.201 to 0.139, β=−0.039).

Table 2. Univariate and multivariate LGM results.

		Model fit				Growth parameters				Covariance					
Model	N	RMSEA	CFI	TLI	SRMR	I_{SE}	S_{SE}	I_{WE}	S_{SE}	I_{SE}–S_{SE}	I_{SE}–I_{WE}	I_{SE}–S_{WE}	S_{SE}–I_{WE}	S_{SE}–S_{WE}	I_{WE}–S_{WE}
LGM SE	397	0.00	1.00	1.00	0.01	3.19*	−0.04	–	–	0.02	–	–	–	–	–
LGM WE	393	0.15	0.89	0.67	0.06	–	–	3.11*	−0.15*	–	–	–	–	–	0.04
LGM WE-M2	393	0.08	0.92	0.92	0.10	–	–	3.11*	−0.16*	–	–	–	–	–	0.05*
MLGM	402	0.05	0.97	0.95	0.09	3.19*	−0.04	3.11*	−0.16*	−0.00	0.08*	0.02	0.01	0.01	0.04*

Note: N = number of observations with FIML, I = intercept, S = slope, SE = self-efficacy, WE = work-engagement, *$P < .05$.

Table 3. Multivariate regression results to predict SE change with WE change.

	Unstandardized			Standardized		
	Estimate	SE	*P*	Estimate	SE	*P*
$Gain_1$ (SE_1–SE_0)						
Intercept	0.017	0.050	.739			
WE_1–WE_0	0.177	0.085	.037*	0.200	0.097	.040*
R^2	0.040					
$Gain_2$ (SE_2–SE_1)						
Intercept	−0.067	0.066	.307			
WE_1–WE_0	−0.031	0.087	.724	−0.039	0.111	.724
R^2	0.002					
$Gain_1$ with $Gain_2$	−0.080	0.022	<.001*	−0.442	0.089	<.001*

Note: *$P < .05$.

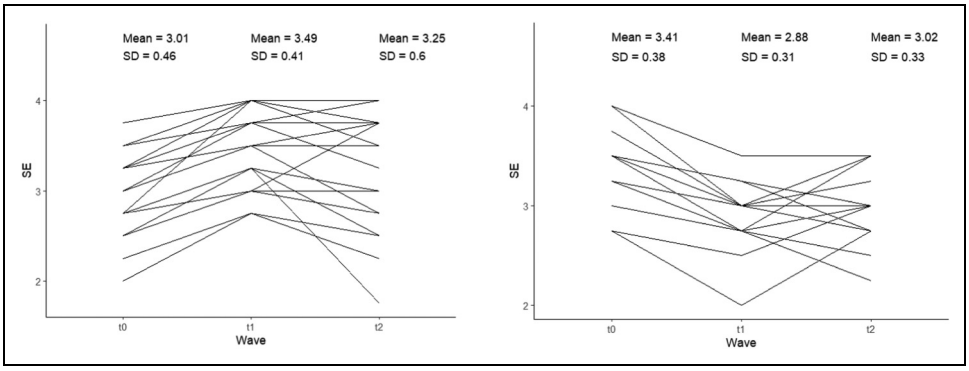


Figure 1. (a, b) Case-by-case analysis of self-efficacy change across measurement points.

Discussion

Our results support the assumption that WE is a positive, fulfilling work-related state, while also indicating that it is malleable and context-dependent. In line with COR theory, this suggests that motivational resources of school leaders are sensitive to substantial changes in their work environment. The decline in WE during the COVID-19 pandemic reflects the consequences of a period in which demands increased substantially while important organizational resources were strained. In light of the debate on stress and strain among school leaders (Groß et al., 2025), this finding highlights the importance of considering the specific conditions of school leadership, as strong engagement constitutes a key motivational resource and an integral part of school leaders' professional identity (Pietsch et al., 2025).

Furthermore, our findings regarding WE are consistent with COR theory's primacy of loss principle (Hobfoll et al., 2018), which posits that resource losses generally have stronger psychological consequences than equivalent resource gains. In the context of COVID-19, the substantial increase in demands alongside the erosion of important organizational resources may have contributed to a gradual loss of WE over time. Importantly, the significant negative slope indicates that this decline was not limited to the acute phase of the pandemic but continued across the observation period from 2019 to 2022,

including the post-pandemic phase. This pattern suggests that the consequences of prolonged resource loss may persist even after the most immediate crisis-related disruptions have subsided.

From a COR perspective, the findings therefore highlight the importance of organizational conditions that prevent further resource loss and facilitate resource replenishment during and beyond periods of prolonged disruption. Accordingly, investments in staffing and material resources should be understood not merely as measures for stress prevention but as essential enabling structures that support school leaders' capacity to sustain their work under demanding conditions (Schmitz and Tulowitzki, 2025). Especially within the bureaucratic German school system, such structural investments may be important for maintaining the capacity for proactive innovation and sustained school development under conditions of uncertainty (Brown et al., 2023).

With regard to SE, our findings point to a differentiated understanding that integrates both stable and dynamic elements. In its original conceptualization, SE refers to individuals' confidence in their ability to successfully perform specific tasks within a given context and is thus considered malleable and open to change (Bandura, 1997). At the same time, subsequent research has conceptualized SE as a more stable, trait-like characteristic (Judge et al., 1998). Our results suggest that both perspectives are relevant in the context of school leadership in crises and I-SE in particular. Although SE remained remarkably stable across the pandemic, the temporary changes observed during the acute crisis phase indicate that it is not entirely unaffected by contextual conditions. Rather, SE appears to represent a relatively stable personal resource that can nevertheless respond to major environmental changes.

In this regard, SE appears to function similarly to a homeostatic system (Marks, 2022), characterized by a relatively stable set point (Lykken and Tellegen, 1996) around which temporary changes may occur in response to contextual demands and resource fluctuations. The stability of SE despite the magnitude of the pandemic-related challenges suggests that school leaders were able to preserve this resource even under highly uncertain conditions. One possible explanation is that the pandemic created numerous opportunities for mastery experiences, as leaders were required to develop and implement novel solutions, redesign communication structures, and adapt organizational routines. Successfully navigating these challenges may have helped maintain confidence in their own capabilities.

At the same time, the temporary coupling of SE and WE during the acute phase provides further insight into the dynamic nature of leaders' psychological resources. When demands were highest, fluctuations in leaders' motivational and cognitive resources became more closely connected. As the pandemic situation stabilized, this association weakened, suggesting that the two resources follow partly distinct developmental trajectories. This finding extends previous research based largely on cross-sectional associations by showing that the relationship between SE and WE may vary depending on the degree of environmental uncertainty.

It remains an open question whether there is a threshold above which particularly resilient and self-efficacious school leaders are able to leverage crisis situations to further strengthen their innovation-related SE. Conversely, it is conceivable that the majority of school leaders, when confronted with overwhelming demands, encounter fewer opportunities for mastery and therefore experience declines in SE. Future research should therefore examine more closely the conditions under which innovation-related SE can be fostered, taking into account not only initial training and formal professional development but also learning processes that occur in the course of everyday professional practice.

These findings also have implications for non-crisis contexts. Although I-SE was temporarily affected by the pandemic, its subsequent return toward its usual level suggests that it may represent a relatively resilient cognitive resource that school leaders can draw on in more stable contexts.

Given its positive associations with leadership behavior (Ugwuanyi and Pietsch, 2026) and innovation (Röhl et al., 2024), I-SE may thus provide an important cognitive basis for sustained school development. At the same time, the observed tendency to return toward its usual level suggests that increases in I-SE resulting from mastery experiences may not necessarily be sustained over time.

Interventions aimed at strengthening I-SE, and thereby leader action self-efficacy, may therefore be particularly effective when implemented shortly before intended changes in school practice, allowing strengthened efficacy beliefs to be directly translated into action and results. More importantly, however, our findings highlight the need to prevent losses in WE. As a motivational resource that may help translate I-SE into sustained leadership action, a loss of WE may constrain the extent to which efficacy beliefs can be mobilized over time. Consistent with COR theory's primacy of resource loss, such losses may also be more difficult to reverse than gains are to achieve. Maintaining WE may therefore be critical for enabling school leaders to mobilize their I-SE effectively and sustain processes of school development and innovation.

Finally, the post-pandemic period highlights that large-scale crises may not only generate resource losses but also create opportunities for adaptation and learning. Crises such as the COVID-19 pandemic can have a catalytic function: they expose existing weaknesses and create opportunities for innovation, particularly in areas such as digitalization. Under favorable conditions, they may also serve as a starting point for professional development among both school leaders and teachers, provided that sufficient space is available for reflection and learning (Dahlin et al., 2018; Williams et al., 2017). Thus, future research should examine how organizational conditions shape whether crises primarily result in resource depletion or stimulate longer-term developmental processes.

Limitations

Despite the longitudinal design and robust analytical approach, several limitations should be acknowledged. First, substantial attrition occurred across the three waves, with missing data reaching approximately 86% at the third measurement point. Although FIML was applied and preliminary *t*-tests indicated no significant differences between participants who remained and those who dropped out, non-random attrition may still introduce selection bias and reduce statistical power (Little and Rubin, 2019).

Second, WE was measured using the ultra-short UWES-3. While validated for efficient assessment (Schaufeli et al., 2019), its brevity may limit the comprehensive nature of vigor, dedication, and absorption. Third, the exclusive reliance on self-report data raises the possibility of common method bias, which can inflate correlations among variables measured within the same survey. Finally, the findings are situated within the German educational system, whose comparatively bureaucratic structure may limit generalizability to more decentralized contexts.

Future research should incorporate multi-perspective designs and objective indicators such as administrative data to reduce common method variance and better link leadership resources to organizational outcomes (Podsakoff et al., 2003). Moreover, studies using shorter measurement intervals (e.g., intensive longitudinal or diary designs) may better capture short-term fluctuations in principal SE over time.

Conclusion

The findings of this study have important implications for understanding how school leaders' psychological resources evolve during systemic crises and beyond. Environmental jolts such as the

COVID-19 pandemic provide rare analytical windows into the dynamics of job demands and resources, making underlying vulnerabilities and stabilization mechanisms particularly visible (Groß Ophoff et al., 2023). This study is one of the few to utilize longitudinal data on school leaders over a 4-year period (2019–2022), spanning the pre-pandemic, acute pandemic, and post-acute pandemic periods.

Our findings indicate that school leaders' psychological resources do not follow a uniform pattern during systemic disruption. While WE declined over the observation period, SE remained comparatively stable, suggesting that cognitive and motivational resources may respond differently to external shocks. The observed homeostatic adjustment points to the relative robustness of SE, while also raising questions about whether this pattern would emerge under more stable conditions and, if so, to what extent and how sustainably SE can be changed.

Importantly, the stability of SE does not imply that it is unaffected by contextual conditions. From a COR perspective, the preservation of personal resources depends on access to contextual resources and resource caravans, that is, bundles of interrelated resources that support individuals in coping with challenging conditions (Hobfoll, 2002, 2011, 2018). In Germany, where school leaders operate with high responsibility but comparatively limited autonomy within a bureaucratic and hierarchical system (Dahle and Wermke, 2024; Mintrop, 2015), maintaining such resources is particularly important given persistent shortages of leadership applicants and limited systematic qualification pathways (Cramer et al., 2021; Klein & Schwanenberg, 2022).

Our findings also have implications beyond crisis contexts. I-SE may represent a relatively resilient cognitive resource that provides an important basis for leadership behavior and sustained school development (Röhl et al., 2024; Ugwuanyi and Pietsch, 2026), whereas WE appears more sensitive to contextual changes. The tendency of I-SE to return toward its usual level suggests that gains from mastery experiences may not necessarily be sustained. Professionalization measures should therefore address both resources in an integrated manner: strengthening I-SE may support leaders' confidence to initiate change, while maintaining WE may be essential for translating these beliefs into sustained leadership action. Such measures should combine opportunities for mastery experiences, collaborative learning, and professional exchange and be embedded in working conditions that support sustained engagement (Toyama et al., 2022).

Ultimately, the relative stability of SE should be understood as a resource that supports adaptation, not as a substitute for organizational support. Establishing and maintaining resource caravans before crises emerge may help prevent future environmental jolts from triggering resource loss processes that undermine school leaders' sustained engagement and capacity for school improvement.

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Data is available upon reasonable request.

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During the preparation of this manuscript, the authors used Gemini and ChatGPT for language editing. After using these tools, the authors reviewed and, if needed, edited the text, so that they take full responsibility for the content of the publication.

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