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Quantitative Research Article

Empowering Leadership and Work Engagement Among Generation Z in the Indonesian Coal Mining Industry: A Multilevel Model Analysis

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Abstract

Background/Problem: The coal mining industry in South Kalimantan, Indonesia, faces increasing challenges in managing Generation Z employees, who now constitute a significant portion of its workforce. While this generation values flexibility, they often demonstrate low work engagement, characterized by high turnover, low motivation, and limited initiative, which threatens operational sustainability.

Objective/Purpose: This study investigates the predictors of work engagement among Generation Z employees in the coal mining sector, utilizing social cognitive theory (SCT). It focuses on empowering leadership, self-efficacy, a supportive work environment, and team learning capability as direct and mediating variables.

Design and Methodology: A quantitative, time-lagged survey design involving 432 participants from four coal companies was employed. Multilevel structural equation modeling (ML-SEM) was conducted to examine both individual- and group-level variables.

Results: Empowering leadership significantly predicted work engagement directly and indirectly through team-level mechanisms. Specifically, self-efficacy ($\beta = .93$, $p < .001$) and a supportive work environment ($\beta = .37$, $p < .001$) acted as mediators in this relationship. In contrast, team learning capability did not demonstrate a significant mediating effect ($\beta = .04$, $p = .13$). These findings underscore the indirect influence of team-level variables on individual engagement outcomes. The final model accounted for 86.1% of the variance in work engagement.

Conclusion and Implications: The study contributes a multilevel, SCT-based framework to explain engagement in labor-intensive industries. Enhancing self-efficacy and fostering supportive leadership and work environments can significantly improve Generation Z's engagement. These findings provide actionable insights for developing sustainable workforce strategies in emerging economies.

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The 17 sustainable development goals (SDGs) of the United Nations have become the primary framework guiding global industries toward sustainable and responsible growth, including the coal sector (Deveci et al., 2022). This industry is often in the international spotlight because of concerns about climate change, deforestation, and community displacement linked to coal mining. As one of the world's leading coal exporters, Indonesia is critical in meeting global energy needs (Admi et al., 2022). In particular, South Kalimantan, especially the coal mining areas in Tanah Bumbu, Tapin, and Kotabaru regencies, serves as a key production hub that directly influences the stability and direction of the international energy market (Werner et al., 2024). While coal mining has significantly contributed to Indonesia's national economy,

new challenges are emerging in human resource management, especially with the entry of Generation Z into the coal mining workforce in South Kalimantan.

Generation Z, defined as individuals born between 1997 and 2012 (Walter et al., 2024), is known for being highly fluent in digital technology, expecting greater flexibility and independence at work, and showing strong concern for environmental and sustainability issues (Sengupta et al., 2024). However, preliminary field studies reveal that this generation struggles with work engagement, as reflected in high turnover rates, absenteeism, and limited involvement in teamwork activities. Human resource practitioners from the four companies examined in this study consistently raised this issue. One human resource (HR) manager explained during the preliminary study that younger employees often resign quickly and display a limited sense of organizational belonging. Such trends pose serious concerns for operational effectiveness and the long-term sustainability of the coal mining sector, a labor-intensive industry.

Despite the strategic importance of this sector and the pivotal role of Generation Z digital natives who demand flexibility and meaningful work (Walter et al., 2024; Sengupta et al., 2024) in shaping its future, there remains little scholarly attention on how to effectively engage this generation in such a physically demanding and traditionally hierarchical industry. This gap highlights the urgent need for research into leadership and organizational mechanisms that can foster sustainable engagement among young workers in the coal mining sector. Existing literature on work engagement has concentrated mainly on the service sector or urban office settings (Kossyva et al., 2023), with minimal exploration of how engagement develops in extreme work environments like coal mining. Furthermore, integrative approaches that connect leadership styles, employee self-efficacy, team learning capabilities, and supportive work environments are rarely examined comprehensively (Qiao et al., 2025).

To address this gap, this study applies the social cognitive theory (SCT; Bandura, 1986) as its theoretical framework to investigate the mechanisms that drive work engagement among Generation Z employees in the coal mining industry. The SCT emphasizes the reciprocal interaction among personal, environmental, and behavioral factors, which in this study are represented by self-efficacy (personal), empowering leadership and a supportive work environment (environmental), and work engagement (behavioral).

Unlike previous studies that explored these variables separately or in less complex contexts, this research employs multilevel structural equation modeling (ML-SEM) to simultaneously examine individual- and team-level influences on work engagement (Mazzetti & Schaufeli, 2022). This methodological approach strengthens the validity of the findings and provides deeper insight into how leadership and contextual factors interact across organizational levels. Specifically, this study explores how empowering leadership affects Generation Z's engagement, focusing on self-efficacy, a supportive work environment, and team learning capability. By integrating psychosocial variables (self-efficacy and work engagement) with organizational variables (empowering leadership, supportive work environment, and team learning capability) into a unified framework, this research makes a theoretical contribution to understanding Generation Z's participation in the coal mining sector. In addition, the study's findings offer practical implications for policymakers and industry leaders, providing strategies to strengthen engagement and improve retention of younger employees, particularly amid the complex challenges of today's work environment.

Literature Review

This section begins with an overview of Indonesia's coal mining sector as the primary research context, underscoring its economic importance and the demographic profile of Generation Z employees. It then introduces the social cognitive theory (SCT) as the central theoretical framework, outlining how personal factors, environmental influences, and behavior influence work engagement. Next, the literature on the key variables in this study is reviewed, including empowering leadership, self-efficacy, a supportive work environment, and team learning capability. Finally, the section explains how these factors are integrated into a multilevel model to formulate the research hypotheses proposed in this study.

Social Cognitive Theory

The social cognitive theory (SCT), introduced by Bandura (1999), argues that human behavior is shaped by a triadic interaction among personal factors, behavior, and environmental influences, a process known as reciprocal determinism. In organizational contexts, this perspective suggests that outcomes such as work engagement are jointly influenced by individual cognition (e.g., self-efficacy), environmental conditions (e.g., empowering leadership and team learning capability), and behavioral responses. SCT is especially relevant for Generation Z, who are more attuned to autonomy, technological integration, and purpose-driven work environments.

Work Engagement

Work engagement is a positive and fulfilling psychological state defined by vigor, dedication, and absorption (Bakker & Demerouti, 2017). In the demanding context of coal mining, engagement is critical in driving productivity, ensuring compliance with safety procedures, and supporting long-term employee retention. For Generation Z employees, who place a high value on meaningful work and strong organizational support, maintaining high levels of engagement is a strategic necessity for organizations aiming for long-term sustainability (Bakker & Demerouti, 2017; Sengupta et al., 2024; Walter et al., 2024). For this reason, work engagement was selected as the primary outcome variable to reflect the behavioral expression of both personal and environmental influences in the workplace.

Empowering Leadership

Empowering leadership involves delegation, participatory decision-making, and support for autonomy and professional development (Amundsen & Martinsen, 2015). In traditionally hierarchical industries such as coal mining, it represents an innovative approach to building trust and fostering psychological empowerment. For Generation Z employees, this leadership style resonates with their preference for involvement, transparency, and opportunities for skill development (Amundsen & Martinsen, 2015; Kim & Beehr, 2023; Sengupta et al., 2024). Accordingly, empowering leadership was identified as a key environmental predictor, expected to play a central role in strengthening engagement among young workers.

Self-Efficacy

Self-efficacy refers to an individual's belief in their capacity to carry out work tasks effectively (Bandura, 1977). Within the framework of SCT, it operates as a cognitive mechanism that transforms external support into motivation and persistence. In high-risk, physically demanding contexts such as coal mining, self-efficacy is essential for maintaining confidence and resilience in the face of operational challenges. Its importance is especially evident among Generation Z employees, who are early in their careers and often need additional support to strengthen their self-belief (Bandura, 1977; Piao & Hahn, 2025; Walter et al., 2024).

Supportive Work Environment

A supportive work environment refers to employees' perceptions of psychological safety, fairness, and consistent support from managers and peers (Naz et al., 2020). Such an environment is consistently linked to lower turnover intentions and higher levels of engagement, especially among younger generations who value inclusion and open communication (Dekel et al., 2022; Naz et al., 2020; Sengupta et al., 2024). In the coal mining sector, where stressors are significant and collaboration is essential, fostering a supportive environment is critical for retaining and engaging Generation Z employees. Accordingly, this variable was included to capture the broader environmental influences that shape engagement outcomes.

Team Learning Capability

Team learning capability refers to a team's collective capacity to acquire, share, and apply knowledge (Batt-Rawden et al., 2019). In dynamic and high-risk work environments, continuous team learning has been shown to enhance adaptability, strengthen safety practices, and drive innovation (Batt-Rawden et al.,

2019; Gerbeth & Mulder, 2023). In structured and hierarchical industries such as coal mining, however, the influence of team learning capability may be more limited compared to other sectors. Even so, this construct is included in the model to examine whether empowering leadership can encourage collective learning behaviors that ultimately strengthen engagement among Generation Z employees.

Multilevel Framework and Hierarchical Structuring

Multilevel modeling is a critical analytical approach in organizational research, particularly when data are hierarchically structured, for example, individuals nested within teams or departments (Zhang, 2025). Ignoring this nested structure can result in biased statistical estimates and misleading interpretations (Kawai et al., 2025). In such contexts, it is necessary to examine both top-down effects, where group-level factors such as leadership and team environment shape individual outcomes, and bottom-up effects, where individual-level experiences influence collective perceptions. This study applies multilevel modeling to analyze cross-level effects within the social cognitive theory (SCT) framework, emphasizing the reciprocal interaction among personal factors, environmental conditions, and behavior (Bandura, 1986). The model incorporates variables at two levels: group and individual. At the group level (Level 2), empowering leadership is treated as the independent variable (predictor), while a supportive work environment and team learning capability function as mediating variables, representing the environmental dimension of SCT. At the individual level (level 1), self-efficacy is a cognitive/personal mediator, and work engagement represents the dependent (behavioral) outcome. This structure allows the study to explore how leadership and team environment shape individual psychological processes and behaviors across different levels. By integrating individual and contextual variables, the model advances an integrative, multilevel perspective in work psychology and aligns with the triadic model of human functioning proposed by SCT (Gutierrez et al., 2022).

Conceptualization of Group-Level Constructs

Empowering leadership (EL) is treated as a team-level construct because leadership behaviors are typically experienced collectively by teams rather than individually. Conceptually, EL encompasses autonomy support, participative decision-making, and coaching, and it is inherently social and observable within team contexts (Amundsen & Martinsen, 2015). When considered at the team level, a supportive work environment (SWE) reflects shared perceptions among team members regarding fairness, psychological safety, and access to resources (Rhoades et al., 2001). These collective beliefs shape emotional and motivational outcomes through social contagion and organizational climate. Similarly, team learning capability represents a group's collective capacity to exchange knowledge, adapt, and reflect (Batt-Rawden et al., 2019). Unlike individual learning, team learning emerges as a higher-order construct, grounded in shared interactions and cooperative behaviors.

Research Hypotheses

Leaders play a vital role in shaping employee behavior, especially in demanding work environments like the coal mining industry. Empowering leadership, defined by autonomy support, participatory decision-making, and encouragement of self-development (Amundsen & Martinsen, 2014), aligns closely with the the SCT (Bandura, 1986) principles, emphasizing the influence of environmental factors on behavior. Empowering leaders creates a work environment in which employees, particularly those from Generation Z, feel trusted, valued, and capable of controlling their performance. When employees experience this sense of empowerment from their supervisors, it strengthens their psychological attachment to work and enhances intrinsic motivation, ultimately fostering higher levels of work engagement (Li et al., 2024). Based on this theoretical framework, the hypotheses are proposed as follows:

H1: Empowering leadership has a positive effect on work engagement.

Empowering leadership is pivotal in shaping how teams learn and grow together. In environments that emphasize shared responsibility and mutual trust, team members are more likely to engage actively in collective learning, thereby strengthening the team's overall learning capability. This capability is especially critical in the coal mining industry where high operational risks demand agility and

interdependence. By creating opportunities for knowledge development and exchange, leaders indirectly foster a culture of continuous learning within their teams (Khatoon et al., 2024). Therefore:

H2: Empowering leadership has a positive effect on team learning capability.

Moreover, the creation of a supportive work environment is strongly influenced by empowering leadership (Kim & Beehr, 2023). Leaders who emphasize transparency, inclusion, and fairness help establish a psychologically safe climate, particularly for younger employees who value emotional support and role clarity. Such an environment builds interpersonal trust and strengthens affective commitment, promoting higher levels of work engagement. Accordingly, the following hypothesis is proposed:

H3: Empowering leadership has a positive effect on a supportive work environment.

Within the framework of the SCT, self-efficacy – defined as an individual's belief in their ability to perform tasks effectively- acts as a mediating variable between leadership and behavioral outcomes. Empowering leaders can enhance self-efficacy by delegating responsibilities, providing constructive feedback on development, and expressing confidence in employees' abilities (Piao & Hahn, 2025). Generation Z employees are more likely to be emotionally and cognitively engaged when they feel capable and confident. Therefore:

H4: Empowering leadership has a positive effect on self-efficacy.

Team learning capability enables employees to collaboratively solve problems, adapt, and innovate (Batt-Rawden et al., 2019). This process fosters a shared sense of purpose and involvement within the organization. Teams that learn together build a collective vision and develop competencies that strengthen work engagement (Gerbeth & Mulder, 2023). Therefore:

H5: Team learning capability has a positive effect on work engagement.

A supportive work environment fosters psychological well-being and positive emotional experiences, as a foundation for work engagement (Yu et al., 2024). In the high-stress context of coal mining, employees who feel supported are more likely to demonstrate resilience and emotional involvement (Bakker & Demerouti, 2017). Thus:

H6: A supportive work environment has a positive effect on work engagement.

Self-efficacy also has a direct impact on work engagement. Employees confident in their ability to handle work challenges demonstrate greater energy, perseverance, and enthusiasm, core dimensions of work engagement (Murillo et al., 2024). Therefore:

H7: Self-efficacy has a positive effect on work engagement.

Finally, this study draws on the mediation logic of SCT, which argues that the indirect influence of environmental and cognitive mechanisms shapes individual behavior. Accordingly, we propose that team learning capability, a supportive work environment, and self-efficacy mediate the relationship between empowering leadership and work engagement. In this way, leaders influence work engagement through direct actions and foster social and psychological conditions that strengthen motivation and commitment (Krasniqi & Hoxha, 2025). Thus, three hypotheses were proposed:

H8: Empowering leadership indirectly affects work engagement through team learning capability.
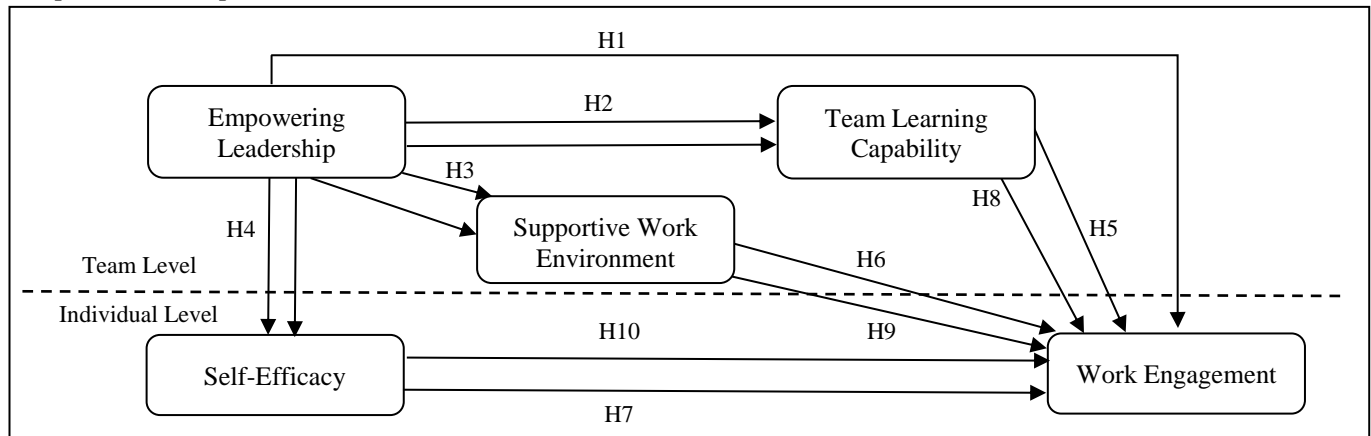H9: Empowering leadership indirectly affects work engagement through a supportive work environment.
H10: Empowering leadership has an indirect effect on work engagement through self-efficacy.

Conceptual Framework

Figure 1 illustrates the study's conceptual framework. The model is grounded in the SCT and incorporates three mediating variables, team learning capability, a supportive work environment, and self-efficacy, which link to the outcome variable of work engagement.

Figure 1
Proposed Conceptual Framework

Note. Solid lines represent direct hypothesized relationships. Broken lines indicate mediating or cross-level relationships examined in the model. All paths correspond to hypotheses H1–H10.

Method

Research Design

This study employs a quantitative research design based on multilevel structural equation modeling (ML-SEM), which is suitable for hierarchically structured data where individuals are nested within teams. Guided by the SCT, the model examines the relationships between empowering leadership, self-efficacy, supportive work environment, team learning capability, and work engagement, while accounting for both team-level and individual-level influences (Zhang, 2025).

In this study, work engagement and self-efficacy are classified as individual-level (level 1) variables, while empowering leadership, a supportive work environment, and team learning capability are conceptualized as group-level (level 2) variables. This classification reflects the nested structure of the organizational setting, where individual employees operate within teams and their functions within departments. Consequently, a multilevel approach is appropriate to examine how psychosocial and contextual factors at different organizational levels interact to influence the engagement of Generation Z employees in the coal mining sector.

Research Setting

The research was carried out in four large coal mining companies operating in South Kalimantan, a province that serves as one of Indonesia's primary coal production centers. Indonesia has over 250 active coal mining companies, most concentrated in Kalimantan. The four participating companies were chosen for their large operational scale, significant employment of Generation Z workers, and willingness to participate in the study. Each is a major private-sector coal mining corporation in South Kalimantan, with an estimated workforce ranging from 1,500 to 3,500 employees. These companies represent highly complex organizational systems with diverse employee demographics, including an increasing proportion of Generation Z workers. They were selected not only for their strategic importance to the industry but also because of their reported high levels of employee engagement and the critical challenges they face in sustaining engagement and retention among younger employees.

Participants

The participants in this study were Generation Z employees (born between 1997 and 2012) working in four coal mining companies. Across these companies, the total estimated population of Generation Z employees was about 1,200, from which 432 respondents were selected using a multistage sampling procedure. The sample included employees from various departments: operations, maintenance, administration, health, safety, and environment (HSE). Involving employees from different work units was

intended to provide a comprehensive picture of work engagement across organizational functions. In addition, the study also included middle managers or supervisors of Generation Z employees.

Sampling and Sample Procedures

A multistage sampling procedure was employed to account for the nested data structure in this multilevel study. Participants were drawn from multiple teams across several coal mining companies in South Kalimantan, Indonesia. At the team level, data were collected from 394 employees and 38 managers representing intact work units. Each team consisted of a group of Generation Z employees supervised by a single manager. Teams were selected using purposive sampling, based on two criteria: each team had to include at least three Generation Z employees (born between 1997 and 2012), and the manager needed to have direct supervisory responsibility. This approach ensured that the sample reflected teams with sufficient generational representation and genuine leader–subordinate interactions.

At the individual level, the 394 Generation Z employees completed the research survey, measuring self-efficacy and work engagement, measuring self-efficacy and work engagement through standardized scales, which captured respondents' individual assessments. Data were collected from both employees and managers for the team-level constructs, including empowering leadership, a supportive work environment, and team learning capability. This dual-source strategy ensured a robust representation of collective team-level perceptions and facilitated valid aggregation procedures required for multilevel analysis.

Instruments

This study employed validated instruments to assess five constructs: empowering leadership, supportive work environment, team learning capability, self-efficacy, and work engagement. All instruments used a 5-point Likert scale (1 = strongly disagree, to 5 = strongly agree). Items were adapted for the Indonesian coal mining context and validated by a panel of experts in organizational behavior, psychology, and human resource management to ensure content validity and contextual appropriateness. Data was collected at individual and team levels to accommodate the multilevel design. At the individual level, items assessing self-efficacy and work engagement were completed solely by Generation Z employees, reflecting their perceptions and experiences. In contrast, at the team level, items for empowering leadership, a supportive work environment, and team learning capability were completed by both team members and their middle managers. This dual-response approach ensured a comprehensive representation of collective perceptions, allowing for the robust aggregation and analysis of group-level constructs. The methodological design was guided by the principles of multilevel modeling and aligned with recommendations for cross-level data collection in organizational research.

Work engagement was measured using the 9-item Utrecht work engagement scale (UWES-9; Schaufeli et al., 2006). The scale demonstrated good internal consistency, with Cronbach's alpha values ranging from .60 to .88 across its three dimensions and between .85 and .92 for the total scale. For example, the vigor dimension includes items such as "At my job, I feel strong and vigorous."

Empowering leadership was measured using a 17-item scale adapted from Sukoco et al. (2022), covering autonomy and developmental support. The instrument demonstrated strong validity (AVE = .81; factor loadings exceeded the recommended cutoff of .50; Hair et al., 2019) and high internal consistency (CR = .97). Both employees and supervisors rated this construct to capture multilevel perceptions. A sample item for the individual level is "My supervisor supports me in achieving my work goals," and for the team level, "I support my employees in achieving their work goals."

The supportive work environment was assessed using 19 items adapted from Naz et al. (2020), further refined by Komalasari et al. (2023) into 16 items. The instrument showed acceptable to high reliability (Cronbach's alpha = .69–.82 across dimensions; CR = .81–.87) and good convergent validity (AVE > .50). Both employees and supervisors responded to items to ensure multilevel evaluation. A sample item for the individual level is, "Team members collaborate to solve problems and achieve shared goals," for the team level, "Team members in my division collaborate effectively to solve problems and achieve team goals."

Team learning capability was measured with an 11-item scale from Batt-Rawden et al. (2019), adapted by Komalasari et al. (2023). The scale covers three dimensions: readiness to learn (RTL), taking the challenge (TTC), and emotional commitment (EC). It demonstrated robust reliability (Raykov's reliability = .77–.91) and validity (factor loadings = .67–.92; AVE > .50; model fit indices SRMR = .05, RMSEA = .08, CFI = .94, TLI = .92). A sample item for the individual level is, "Our team reflects together on improving performance." In contrast, for the team level, "I encourage my team to reflect together on improving performance."

Finally, self-efficacy was measured using the general self-efficacy scale (Bosscher & Smit, 1998), which assesses an individual's confidence in completing tasks independently. The instrument has demonstrated acceptable reliability (α = .69) and satisfactory fit indices (e.g., GFI = .98; CFI = .94; NFI = .93). A sample item is, "I can always manage to solve difficult problems if I try hard enough."

Procedure

The research commenced with formal approval from the participating companies, which was granted following a presentation to their leadership. The research instrument was adapted per the guidelines of the International Test Commission (2017), including translation, expert validation, and pilot testing. Data collection was conducted in two stages (time-lagged) to minimize common method bias. In the first stage, middle managers were group respondents for empowering leadership, a supportive work environment, and team learning capability. At the same time, Generation Z employees responded to empowering leadership, self-efficacy, and supportive work environment measures. The second stage occurred two weeks later, during which Generation Z employees completed the work engagement and team learning capability surveys.

Results

The structural model was analyzed using structural equation modelling (SEM) in Mplus version 8.8, with maximum likelihood (ML) estimation. A time-lagged design minimizes common method bias, with a two-week interval between predictor and outcome variables. This procedural strategy is widely recognized as effective in reducing perceptual biases associated with the simultaneous administration of questionnaires. Accordingly, the risk of common method bias in this study is considered low and unlikely to significantly affect the validity of the relationships among constructs. After data screening and validation, responses from 432 participants were retained for analysis, comprising 394 Generation Z staff members and 38 mid-level managers from four coal mining companies in South Kalimantan. The distribution of staff respondents across companies was as follows: company A (*n* = 99), company B (*n* = 78), company C (*n* = 113), and company D (*n* = 104). Within the staff group, the majority were aged 23–27 years (74.11%), followed by 28–32 years (25.89%), with no respondents above 32 years. This reflects the predominance of Generation Z and early millennials, an age group characterized by high adaptability to technology and strong expectations regarding work–life balance and organizational support. In contrast, the manager group displayed a more mature age distribution, with the majority aged 33–37 years (55.26%), followed by 38–42 years (21.05%) and over 42 years (23.68%), indicating that individuals generally fill leadership positions with greater work maturity and experience.

Overall, the sample was dominated by men, with 401 respondents (92.82%), while women accounted for 31 respondents (7.18%), reflecting the gender composition typically found in the coal mining industry. Table 1 provides a comprehensive overview of the respondents' demographic characteristics, categorized by job title, age, and gender. The SEM analysis was conducted in two main stages: (1) measurement model testing, to assess the validity and reliability of the constructs, and (2) structural model estimation, to evaluate the relationships between variables, including mediation testing and multi-group analysis. This approach enables the simultaneous examination of complex causal relationships within the model and allows for adjustments based on moderating variables such as job title and age. The demographic characteristics of respondents by job title, age, and gender are presented in detail in Table 1, which also highlights the age distribution between Generation Z staff and mid-level managers in the study:

Table 1
Demographic Sample

Age (Years)	Manager	Percentage	Staff	Percentage
23–27	–	–	292	74.10
28–32	–	–	102	25.90
33–37	21	55.30	–	–
38–42	8	21.10	–	–
> 42	9	23.90	–	–
Total	38	100.00	394	100.00

After describing the demographic characteristics of the respondents in Table 1, the next step is to test the extent to which empirical data support the research model. Model fit was evaluated using several goodness-of-fit indicators presented in Table 2. Given the study's multilevel design, these indices were calculated from the initial measurement model, which incorporated individual- and group-level data. This step ensured the overall model structure was acceptable before assessing construct validity and reliability (AVE and CR).

Table 2
Goodness of Fit Indices

Index	Value	Threshold	GoF Conclusion
Chi-Square	31024.37 (*df*, 2005)	.50	
RMSEA	.18	.05–.08	Unfit model
CFI	.51	0–1.00	Model fit, but ideally, the CFI value is above .95
TLI	.49	.80–.90	Unfit model
SRMR	.06	< .08	Model fit

Note. CFI = Comparative Fit Index; TLI = Tucker–Lewis Index; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Square Residual.

The chi-square value of 31024.37 with 2005 degrees of freedom is statistically significant ($p < .05$), indicating a mismatch between the model and the empirical data. However, because the chi-square test is susceptible to large sample sizes, it is not relied upon exclusively to assess model fit. The RMSEA value .18 exceeds the acceptable threshold ($\leq .08$), indicating poor model parsimony. Similarly, the CFI (.51) and TLI (.49) fall well below the recommended minimums of .90 and .80, respectively, suggesting that the model does not fit well (Peugh et al., 2023). In contrast, the SRMR value of .06 is below the .08 cut-off, indicating acceptable predictive accuracy. Among the five goodness-of-fit (GoF) indices, only SRMR demonstrates a satisfactory result. Despite the poor overall model fit, the structural model remains interpretable, as all constructs meet convergent validity and reliability criteria: factor loadings are valid, AVE values exceed .5, and CR values are above .70 (Hair et al., 2020). This supports the theoretical validity of the model despite its statistical limitations. Details of the AVE and CR evaluation results for each construct are presented in Table 3.

Table 3
Construct Validity and Reliability Results

Construct	AVE	CR	Conclusion
Work Engagement	.69	.95	Valid and Reliable
Self-efficacy	.67	.96	Valid and Reliable
Empowering leadership	.65	.88	Valid and Reliable
Team learning capability	.71	.96	Valid and Reliable
Supportive work environment	.55	.70	Valid and Reliable

Note. AVE = Average Variance Extracted; CR = Composite Reliability.

The average variance extracted (AVE) assesses the proportion of variance a construct explains relative to measurement error. An AVE value of ≥ .50 indicates adequate convergent validity (Hair et al., 2020), and all constructs in this study met this criterion. The highest AVE was observed for team learning capability (.71), while the lowest was for supportive work environment (.55), exceeding the acceptable threshold. Composite reliability (CR), which reflects internal consistency, also met the recommended standard of ≥ .70 for all constructs (Hair et al., 2020). Team Learning Capability reported the highest CR (.96), whereas the supportive work environment had the lowest (.70), which still falls within the acceptable range. Beyond individual-level validity and reliability, the study also established the statistical justification for aggregating data at the team level. Accordingly, aggregation indicators – including intraclass correlation coefficients [ICC(1) and ICC(2)] and the within-group agreement index (rWG) – were evaluated for each construct analyzed at the team level. The results of this evaluation are presented in Table 4.

Table 4
Evaluation of Intraclass Correlation Coefficients and the Within-Group Agreement Index

Variable	p–value	ICC(1)	ICC(2)	rWG	SD
Empowering leadership	.001	.31	.81	.94	.06
Team learning capability	.001	.46	.90	.99	.01
Supportive work environment	.001	.46	.91	.99	.00

Note. ICC = Intraclass Correlation; ICC(1) = reliability of individual ratings within groups; ICC(2) = reliability of group means; rWG = within-group agreement index, which indicates the extent of consensus among team members; SD = standard deviation.

For empowering leadership (EL), the ICC(1) value of .31 indicates that 31% of the variance in perceptions is attributable to group differences, exceeding the .12 threshold and supporting group-level aggregation. The ICC(2) value of .81 demonstrates high reliability, while the rWG of .94 and SD of .06 indicate strong agreement and perceptual homogeneity within groups. For team learning capability (TLC), the ICC(1) is .46 and ICC(2) is 0.90, both supporting aggregation. The rWG reaches .99, indicating nearly complete within-group agreement, reinforced by a very low SD of .01. Similarly, for the supportive work environment (SWE), ICC(1) is 0.46, ICC(2) is .91, and rWG is .99, with an SD of .00, indicating no variation within groups. Altogether, these metrics statistically and conceptually justify aggregating EL, TLC, and SWE at the team level. Therefore, the subsequent analysis is conducted at the aggregate level to test the relationships among variables using the developed conceptual model. The results of the hypothesis testing are presented in Table 5.
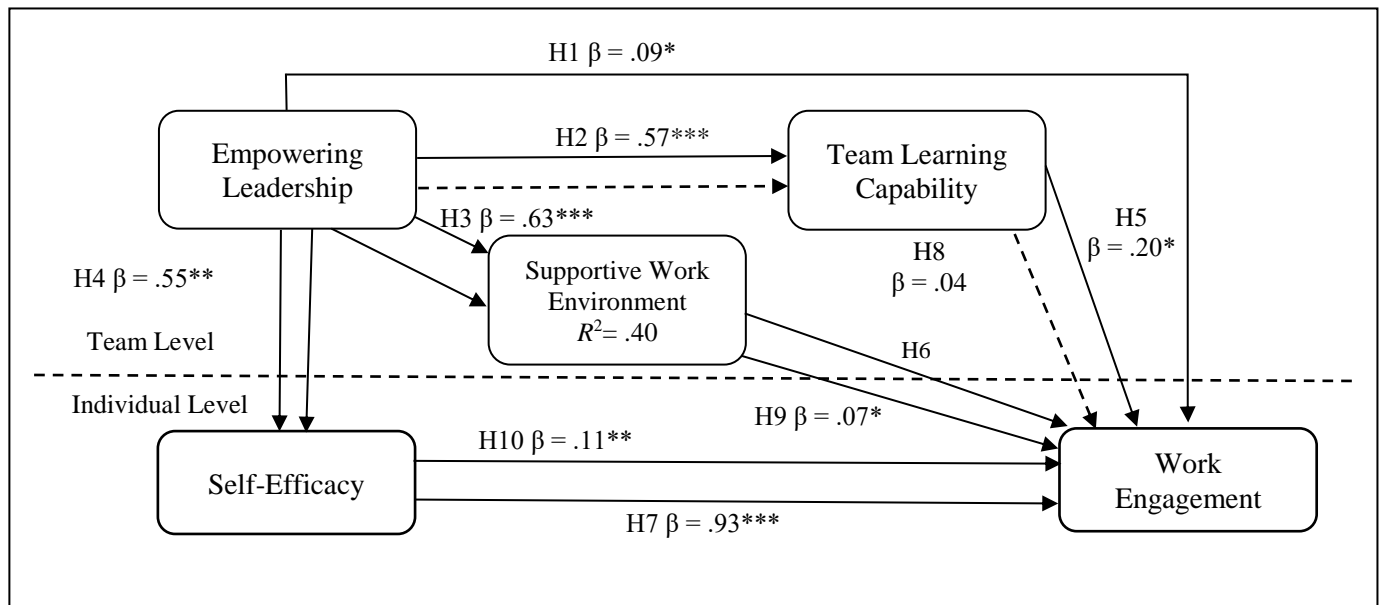
Table 5
Hypotheses Testing Results

H	Path	Estimate	Est./SE	p–value	Conclusion
H1	EL → WE	.09	2.48	.01	Accepted
H2	EL → TLC	.57	4.24	.00	Accepted
H3	EL → SWE	.63	4.96	.00	Accepted
H4	EL → SE	.55	2.80	.01	Accepted
H5	TLC → WE	.20	2.46	.01	Accepted
H6	SWE → WE	.37	3.47	.00	Accepted
H7	SE → WE	.93	193.90	.00	Accepted
H8	EL → TLC → WE	.04	1.52	.13	Rejected
H9	EL → SWE → WE	.07	2.59	.01	Accepted
H10	EL → SE → WE	.11	2.88	.00	Accepted

Note. EL = empowering leadership; WE = work engagement; SWE = supportive work environment; TLC = team learning capability; SE = self-efficacy; Est./SE = Estimate divided by Standard Error.

The first seven hypotheses (H1–H7) were accepted. Empowering leadership (EL) significantly influenced work engagement (WE) directly ($\beta = .09$; Est/SE $= 2.48$; $p = .01$), team learning capability (TLC) ($\beta = .57$; $p < .001$), supportive work environment (SWE) ($\beta = .63$; $p < .001$), and self-efficacy (SE) ($\beta = .55$; $p = .01$). TLC, SWE, and SE each positively affected WE ($\beta = .20$, $.37$, and $.93$, respectively; all $p < .05$), with SE showing the most potent predictive effect. Among the mediation hypotheses, H8 was rejected (TLC mediation: $\beta = .04$, $p = .13$), indicating that TLC does not significantly mediate the relationship between EL and WE. However, H9 and H10 were supported: SWE ($\beta = .07$, $p = .01$) and SE ($\beta = .11$, $p < .001$) significantly mediated the relationship between EL and WE, confirming indirect effects through these variables. R-squared (R^2) analysis shows EL explains 32.90% of the variance in TLC ($R^2 = .33$; $p = .03$), 40.10% in SWE ($R^2 = .40$; $p = .01$), and 29.90% in SE ($R^2 = .30$). The full model accounts for 86.10% of the variance in WE ($R^2 = .86$; $p < .001$), indicating a strong explanatory power of the combined predictors: EL, TLC, SWE, and SE. In summary, the findings support the central role of EL in shaping individual and team dynamics, with SE and SWE acting as key mediators in enhancing work engagement. Despite TLC's contribution to WE, its role as a mediator was not statistically supported. To comprehensively visualize the direction of the relationship between constructs, the strength of path estimation, and the contribution of each variable to the dependent variable, refer to Figure 2 below, which describes the results of the complete hypothesis test along with the R-squared value for each construct.

Figure 2
Hypotheses Testing Results

Note. Dashed lines = not significant; solid lines= significant. * $p < .05$, ** $p < .01$, *** $p < .001$.

To evaluate the fit of the multilevel structural equation model, a series of model fit indices were examined in line with established cut-off criteria (Hair et al., 2020). The indices included the comparative fit index (CFI), Tucker–Lewis index (TLI), root mean square error of approximation (RMSEA), and standardised root mean square residual (SRMR). The final model yielded the following values: CFI = .95, TLI = .94, RMSEA = .04, and SRMR = .03, indicating a good model fit. These results suggest that the hypothesised multilevel model adequately represents the observed data. All reported path coefficients were based on the final model, which demonstrated acceptable fit, ensuring that the coefficients are unbiased and suitable for interpretation. Multilevel confirmatory factor analysis (MCFA) also indicated good fit ($\chi^2/df < 3$, CFI = .95, TLI = .94, RMSEA = .05, SRMR = .04), supporting the validity of the measurement model. Subsequent structural modelling was conducted in Mplus Version 8.9 using robust maximum likelihood estimation to account for the nested data structure.

Discussion and Conclusion

Discussion of Main Results

The findings confirm that empowering leadership significantly impacts work engagement among Generation Z employees in Indonesia's coal mining sector. The Indonesian context is particularly relevant, as the country is one of the world's largest coal exporters, and labor-intensive operations and hierarchical organizational structures characterize its mining industry. These conditions, combined with the growing presence of Generation Z in the workforce, underscore the importance of leadership approaches that promote autonomy, psychological support, and employee engagement. While the direct effect of empowering leadership may be relatively modest, its influence becomes significantly stronger when mediated by self-efficacy and a supportive work environment. These findings support the central propositions of social cognitive theory (Bandura, 1986), which posits that behavior results from the reciprocal interaction of cognitive, environmental, and behavioral factors. Within this framework, empowering leadership and a supportive work environment serve as external environmental influences, self-efficacy represents the internal cognitive factor, and work engagement reflects the behavioral outcome (Cui & Sun, 2025).

The strong mediating effect of self-efficacy highlights its role as a cognitive core in sustaining motivation and engagement. This finding is consistent with prior research identifying self-efficacy as a key predictor of workplace motivation and psychological resilience (Bandura, 1999; Wen-Chi, 2025). Individuals with high self-efficacy tend to take initiative, persist through challenges, and exhibit psychological resilience (Wen-Chi, 2025). In labor-intensive industries such as coal mining, this confidence in handling demanding tasks is critical for maintaining energy and well-being. Recent studies further emphasize the importance of self-efficacy in promoting work motivation and engagement, particularly in high-pressure environments (Walter et al., 2024).

A supportive work environment also emerged as a critical mediator, emphasizing how environmental cues influence cognitive and emotional responses. According to social cognitive theory (SCT), social reinforcement and psychological safety enhance self-belief, affecting motivation (Bandura, 1999). Consistent with recent findings, supportive workplace climates foster emotional connection, increase engagement, and reduce psychological strain, particularly among younger employees (Kim & Beehr, 2023).

In contrast, the mediating role of team learning capability was not statistically significant. This outcome can be interpreted through the lens of SCT, which acknowledges that environmental mechanisms do not exert uniform effects across all contexts. In rigid and hierarchical sectors such as coal mining, team-based reflection and shared learning opportunities are often structurally limited. As a result, SCT mechanisms such as vicarious learning and social modeling may not function effectively in this environment (Gerbeth & Mulder, 2023).

The findings confirm that empowering leadership enhances work engagement directly and indirectly through contextual and cognitive resources. Among the mediating variables, self-efficacy emerged as the strongest pathway, indicating that a leader's ability to instill confidence in employees is the most critical driver of engagement. A supportive work environment also functioned as a mediator, though to a lesser extent, suggesting that while organizational context is important, its influence is secondary to individual cognitive beliefs. In contrast, team learning capability did not significantly mediate the relationship, possibly reflecting the operational characteristics of the coal mining industry, where individual responsibility and leader support are more prominent than collective learning. These distinctions highlight the primacy of personal efficacy as a psychological mechanism for engagement, while reaffirming the value of supportive environments.

Finally, the multilevel structural equation modeling (ML-SEM) approach strengthens the study's theoretical contribution by capturing cross-level interactions that reflect the principle of reciprocal determinism in social cognitive theory (Bandura, 1986). Empowering leadership, supportive work environment, and team learning capability were conceptualized at the team level, while self-efficacy and

work engagement were assessed individually. This cross-level design illustrates the dynamic interplay between contextual and personal factors in shaping workplace behavior. The high explanatory power of the final model ($R^2 > .86$) underscores the relevance of SCT in explaining work engagement across hierarchical levels in labor-intensive industries (Bakker & Demerouti, 2017).

Limitations

This research has limitations that must be considered, particularly regarding the structural context of work in the coal mining industry. This context strongly emphasizes individual achievement and operational efficiency, reducing the scope for collaborative team dynamics. Such work characteristics may hinder the optimal development of team learning capability as a mediator between empowering leadership and work engagement, especially in a work context that prioritizes team collaboration. Consequently, the findings should be interpreted within work environments characterized by unstable and results-oriented team structures, such as those in the coal mining sector. To enhance the external validity of the conceptual model, further research is recommended to explore similar dynamics in sectors with work structures that are more conducive to collaboration and continuous team learning, such as high-tech manufacturing, education, or healthcare, which provide greater structural and cultural support for collective engagement in achieving common goals.

Implications for Behavioral Science

This research contributes to behavioral science by extending the SCT (Bandura, 1986), which emphasizes the reciprocal interaction of personal, social, and environmental factors, into the context of Generation Z employees in labor-intensive industries. The finding that self-efficacy is the strongest predictor underscores its central role in sustaining work engagement (Bakker & Demerouti, 2017; Walter et al., 2024).

Empowering leadership and supportive work environments further highlight the importance of systemic and social interventions that enhance motivation and collective learning (Amundsen & Martinsen, 2015; Kim & Beehr, 2023). These strategies are particularly relevant for Generation Z, who prioritize openness, collaboration, and psychological recognition (Sengupta et al., 2024).

The study advances generational perspectives in behavioral science by demonstrating that Generation Z responds distinctly to organizational factors, reinforcing the need for adaptive leadership and policies aligned with evolving work values (Yu et al., 2024).

Conclusion

This study highlights the critical role of empowering leadership, a supportive work environment, and self-efficacy in enhancing work engagement among Generation Z employees in the coal mining industry. Self-efficacy emerged as the strongest predictor, emphasizing the importance of employee confidence in sustaining motivation and productivity. While team learning capability was not a significant mediator, it remains relevant for fostering adaptability in organizational settings. The findings reinforce the SCT and provide practical guidance for leaders to create supportive and empowering workplaces that align with United Nation's SDGs, especially 8 and SDG 9. Engaging Generation Z is an operational necessity and a long-term strategic investment for sustainable organizational growth.

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