



Transformational leadership, teacher motivation, and upskilling-reskilling as determinants of 21st-century teacher competencies

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ABSTRACT

The integration of digital technology and artificial intelligence into the learning ecosystem has increased global demands for teacher competency. This study examines the simultaneous and partial effects of transformational leadership (X1), teacher motivation (X2), and upskilling and reskilling (X3) on 21st-century teacher competency (Y). This study was conducted because no empirical study has simultaneously tested these three variables in a single regression model among elementary and junior high school teachers in Indonesia. We used a quantitative explanatory correlational approach, collecting data from 238 teachers in West Java through a 40-item Likert-scale online questionnaire and analyzing them using multiple linear regression. All items were valid and highly reliable. The model explained 84.5% of the variance in teacher competency. Three predictors had a significant influence: 1) Transformational leadership; 2) Teacher motivation; and 3) Upskilling and reskilling. Upskilling and reskilling were the most dominant predictors, confirming that continuous skill development is the most direct path to developing 21st-century teacher competency.

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ABSTRAK

Integrasi teknologi digital dan kecerdasan buatan ke dalam ekosistem pembelajaran telah meningkatkan tuntutan global terhadap kompetensi guru. Penelitian ini mengkaji pengaruh simultan dan parsial kepemimpinan transformasional (X1), motivasi guru (X2), serta upskilling dan reskilling (X3) terhadap kompetensi guru abad ke-21 (Y). Penelitian ini dilaksanakan karena belum ada kajian empiris yang secara bersamaan menguji ketiga variabel tersebut dalam satu model regresi dalam konteks guru SD/MI dan SMP/MTs di Indonesia. Pendekatan kuantitatif eksplanatori korelasional digunakan; data dikumpulkan dari 238 guru di Jawa Barat melalui kuesioner daring berskala Likert dengan 40 butir pernyataan, kemudian dianalisis menggunakan regresi linier berganda. Seluruh butir valid dan memiliki reliabilitas yang tinggi. Model menjelaskan 84,5% variansi kompetensi guru. Ketiga prediktor berpengaruh signifikan: 1) Kepemimpinan transformasional; 2) Motivasi guru; serta 3) Upskilling dan reskilling. Upskilling dan reskilling merupakan prediktor paling dominan yang menegaskan bahwa pengembangan keterampilan berkelanjutan merupakan jalur paling langsung dalam pembentukan kompetensi guru abad ke-21.

Kata Kunci: kepemimpinan transformasional; kompetensi guru abad ke-21; motivasi guru; upskilling dan reskilling

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INTRODUCTION

The rapid advancement of education in the Industry 4.0 and Society 5.0 era has placed unprecedented demands on teachers globally. Technological disruption, the proliferation of artificial intelligence, and the shift toward learner-centered pedagogies have fundamentally altered the professional requirements for effective teaching. Six competency domains have emerged as universal benchmarks for teacher professional excellence: critical thinking, creativity and innovation, communication, collaboration, digital literacy, and adaptability, in line with Cukurova & Miao (2024) in *"AI Competency Framework for Teachers"*. These domains collectively define 21st-century teacher competencies, and their systematic development has become central to educational policy and research worldwide. Teachers are no longer expected to function merely as knowledge transmitters; they must serve as adaptive, innovative, and critically reflective facilitators of learning who can navigate the technological and pedagogical complexities of contemporary education.

In Indonesia, this imperative has taken on acute urgency. The Kurikulum Merdeka, introduced in 2022, represents a significant policy shift toward differentiated instruction, project-based learning, and deep digital technology integration in teaching and learning (Aziz et al., 2025; Dirgantara et al., 2025; Nuraini et al., 2023; Tarbiyah et al., 2025). However, empirical studies consistently reveal a persistent structural gap between the curriculum's competency demands and teachers' actual readiness, particularly at the elementary (SD/MI) and junior secondary (SMP/MTs) levels, where access to professional development remains unequal across regions (Hidayat et al., 2023). Digital literacy and digital analysis remain the weakest competency dimensions among Indonesian primary teachers, precisely those most critical for supporting the Kurikulum Merdeka in the digital classroom (Bentri et al., 2022).

This gap is not merely a matter of individual teacher capacity. It reflects systemic shortfalls in school leadership, motivational conditions, and structured skill-development programs that together determine whether teachers can meet the evolving demands of modern classrooms. Three interrelated pillars are theorized as the primary determinants of this competency formation. First, transformational leadership, operationalized through Idealized Influence, Inspirational Motivation, Intellectual Stimulation, and Individualized Consideration, catalyzes professional growth among teaching staff, in line with Bass & Avolio (1994) in *"Improving Organizational Effectiveness through Transformational Leadership"*. A meta-analysis of 65 studies across Asia confirmed its positive influence on teacher satisfaction, commitment, and self-efficacy (Firmansyah et al., 2022). A multilevel structural equation modeling study across 56 Turkish schools further demonstrated significant indirect effects on teacher innovative practices through commitment and trust in the principal (Kiling et al., 2024).

These findings position transformational leadership as a structural determinant of teachers' capacity to develop and sustain 21st-century competencies. Second, Self-Determination Theory (SDT) establishes that motivational quality, not quantity, determines the sustainability of professional engagement (Deci & Ryan, 2000). Autonomous motivation predicts participation in professional learning more reliably than controlled forms (Uysal, 2023). Intrinsic motivation also directly predicts engagement in professional learning

communities, confirming that the quality, rather than intensity, of motivation shapes professional development outcomes (Belay & Melesse, 2024; Haliza & Handayani, 2026). Third, upskilling (deepening existing competencies) and reskilling (acquiring wholly new skills) have become non-negotiable in the AI era (Li, 2024). Institutional support and self-efficacy are the key enablers of sustained reskilling engagement (Patre et al., 2023). Despite these theoretical imperatives, teacher digital competence gaps remain acute and empirically documented in Indonesian classrooms (Mulyanti et al., 2024). Despite rich individual literature on each pillar, a critical empirical gap persists.

Prior studies have largely examined these determinants in isolation or in paired combinations, without testing all three simultaneously in a single analytical model. Prior research has documented each pillar separately. The effect of transformational leadership on teacher performance is well established (Firmansyah et al., 2022; Kılınç et al., 2024). The role of autonomous motivation in professional development has also been confirmed (Belay & Melesse, 2024; Wang et al., 2024). The connection between digital competence and curriculum demands has similarly been documented (Bentri et al., 2022). To the authors' knowledge, no published study has simultaneously tested the relative effects of Transformational Leadership, Teacher Motivation, and Upskilling and Reskilling as distinct predictors of 21st-Century Teacher Competencies within a single regression model using Indonesian elementary and junior secondary field data.

This gap matters not merely for theory building but for evidence-based policy: without comparative effect sizes for all three determinants, school leaders and education authorities cannot make empirically grounded resource-allocation decisions about which pillar merits priority investment. This study addresses the gap through three distinct contributions. First, it simultaneously tests the partial and joint effects of all three predictors in one integrated regression model, enabling direct comparison of their relative effect magnitudes, not merely statistical significance. Second, it employs a multi-district field dataset of $N = 238$ respondents spanning SD/MI and SMP/MTs, offering greater ecological breadth than single-school or single-district studies that dominate the existing Indonesia literature. Third, it explicitly reports and interprets standardized beta coefficients, producing actionable, policy-relevant evidence about which determinant yields the greatest leverage for competency improvement.

The following research questions guided this study: 1) Does transformational leadership exert a significant positive effect on 21st-century teacher competencies?; 2) Does teacher motivation exert a significant positive effect on 21st-century teacher competencies?; 3) Does upskilling and reskilling exert a significant positive effect on 21st-century teacher competencies?; 4) Do all three variables simultaneously exert a significant positive effect on 21st-century teacher competencies? This study therefore aims to analyze the magnitude of partial and simultaneous effects of Transformational Leadership, Teacher Motivation, and Upskilling and Reskilling on 21st-Century Teacher Competencies among SD/MI and SMP/MTs teachers, and to determine which predictor contributes most decisively to competency formation as an empirical basis for school-level human resource development decisions.

LITERATURE REVIEW

Transformational Leadership

Bass & Avolio (1994), in *"Improving Organizational Effectiveness through Transformational Leadership"* explained that transformational leadership moves beyond transactional exchange by inspiring followers toward a shared, higher-order vision through four dimensions. Idealized Influence establishes moral exemplarity that builds follower trust and motivates followers to internalize the leader's standards. Inspirational Motivation involves articulating a compelling, emotionally resonant vision that sustains collective enthusiasm and frames goals in meaningful terms. Intellectual Stimulation involves provoking creative and critical thinking through challenging existing assumptions and legitimizing unconventional professional approaches. Individualized Consideration describes personalized coaching, mentoring, and developmental feedback tailored to each teacher's unique growth aspirations. In school contexts, these dimensions translate into concrete leadership behaviors that shape the professional environment.

Transformational school leadership positively predicts teachers' use of differentiated instruction through the mediating effects of collaboration and self-efficacy (Ninković et al., 2024). It directly influences teacher commitment and engagement in professional learning communities (Roesminingsih & Windasari, 2025). Principal transformational leadership also positively affects teachers' innovative behavior through their sense of meaning at work, moderated by uncertainty avoidance (Bao, 2024). Together, these findings confirm that transformational leadership functions as a structural enabler that cultivates a psychological climate of trust, meaning, and intellectual freedom. Within this study's conceptual framework, transformational leadership is operationalized as the *enabling condition*: the prerequisite environmental variable that creates necessary but not sufficient conditions for 21st-century competency formation, in line with Bass & Avolio (1994) in *"Improving Organizational Effectiveness through Transformational Leadership"*.

Teacher Motivation

SDT posits that motivational quality, not intensity, determines the depth, sustainability, and outcomes of professional engagement (Deci & Ryan, 2000). Motivation is not a unidimensional quantity but a qualitatively differentiated continuum from amotivation through controlled extrinsic regulation to fully autonomous intrinsic motivation. SDT's central insight is that autonomous motivation, encompassing intrinsic motivation and well-internalized identified regulation, consistently predicts better professional outcomes than controlled motivation across educational contexts. Individuals whose motivation is autonomous engage more deeply, persist more sustainably, and achieve greater creativity and quality in their professional activities than those acting primarily under external pressure or obligation.

Three basic psychological needs mediate this motivational continuum: *autonomy* (experiencing oneself as the origin of one's behavior and having meaningful choices in professional practice), *competence* (experiencing mastery and effectiveness in challenging tasks), and *relatedness* (feeling meaningfully connected to and cared for by members of

one's professional community). When autonomy-supportive leadership, competence-building professional development, and collaborative professional communities satisfy these needs, teachers are more likely to internalize professional growth goals and engage in sustained, self-directed learning (Ryan & Deci, 2020). Meeting these needs in school contexts requires deliberate organizational conditions, linking motivation directly to the enabling role of transformational leadership. Empirical evidence strongly supports these theoretical propositions.

Task autonomy and principal support are the school-level conditions most strongly associated with teachers' autonomous motivation for continuous professional development (Zhang et al., 2022). A systematic review of 48 empirical studies confirmed that intrinsic motivation is the most robust predictor of sustained professional development engagement across diverse educational settings (Uysal, 2023). Indonesian secondary teachers motivated by autonomous rather than controlled reasons demonstrate broader and more sustained professional growth engagement (Purwanti & Octavia, 2022). A meta-analysis of 36 SDT-based educational interventions further confirmed that autonomy support and competence satisfaction are the key mechanisms through which intrinsic motivation is cultivated in educational settings (Wang et al., 2024). This study operationalizes teacher motivation as the internal driver: the psychological mechanism channeling leadership's enabling conditions into active skill-development behavior (Deci & Ryan, 2000).

Upskilling and Reskilling

Two complementary strategies define contemporary professional development. Upskilling refers to systematically deepening existing skills, advancing competencies to higher levels of mastery. Reskilling, by contrast, denotes acquiring entirely new skills in new domains of knowledge, new pedagogical methods, or new digital tools (Li, 2024). Both strategies respond to the same structural force: the accelerating pace at which AI penetration, shifting pedagogical paradigms, and evolving learner characteristics render existing competencies insufficient. Key enablers of sustained reskilling engagement include institutional support, perceived relevance, and self-efficacy (Patre et al., 2023).

Structured upskilling and reskilling are the strongest determinants of teacher digital competence in Indonesian schools, with curriculum support and institutional resources as critical enabling factors (Mulyanti et al., 2024). Well-structured programs aligned to specific classroom needs produce measurable competency increases among Indonesian elementary school teachers (Rachmadtullah et al., 2025). This study operationalizes Upskilling and Reskilling across three sub-dimensions: upskilling (enhancing existing pedagogical skills), reskilling (acquiring new methods and technologies), and continuous learning (sustained engagement in workshops, courses, and professional learning communities). This construct functions as the direct competency-formation mechanism: the behavioral pathway through which enabling conditions and autonomous motivation translate into measurable 21st-century competency gains (Li, 2024; Patre et al., 2023).

21st-Century Teacher Competencies

UNESCO's frameworks define 21st-century teacher competencies through six inter-related domains that constitute the profile of the effective contemporary educator: Critical Thinking (evidence-based pedagogical decision-making), Creativity and Innovation (designing novel instructional experiences), Communication (adapting content delivery to diverse learners), Collaboration (co-planning and professional learning community engagement), Digital Literacy (evaluating and integrating AI-enabled instructional tools), and Adaptability (flexible response to policy, curriculum, and technological change) (see: <https://www.unesco.org/gem-report/en/publication/technology>). These domains are not merely policy aspirations: Indonesian university teachers' integration of the 4Cs remains in the "approaching competency" category (Herlinawati et al., 2024). Professional development competency needs cluster most strongly around digital integration and innovative instructional design (Kırkıç et al., 2025). These convergent findings confirm that structured, targeted interventions are essential for closing the identified 21st-century competency gaps.

Conceptual Framework and Hypotheses

This study constructs a three-component framework in which 21st-Century Teacher Competencies (Y) is the outcome variable jointly determined by three predictors: Transformational Leadership (X1) as the enabling condition, Teacher Motivation (X2) as the internal driver, and Upskilling and Reskilling (X3) as the direct competency-formation mechanism. The model implies a theoretically coherent causal sequence: leadership creates the conditions; motivation activates engagement; and upskilling-reskilling delivers competency outcomes. X3 is predicted to be the strongest direct predictor given its proximal relationship to competency formation. Based on this framework, the following hypotheses are tested:

- H1: Transformational Leadership exerts a positive and significant partial effect on 21st-Century Teacher Competencies.
- H2: Teacher Motivation exerts a positive and significant partial effect on 21st-Century Teacher Competencies.
- H3: Upskilling and Reskilling exert a positive and significant partial effect on 21st-Century Teacher Competencies.
- H4: All three variables simultaneously exert a positive and significant effect on 21st-Century Teacher Competencies.

METHODS

Research Design and Participants

This study employed a quantitative explanatory-correlational design, appropriate when the researcher seeks to determine the direction and strength of predictive relationships among naturally occurring variables, in line with Creswell & Creswell (2017) in *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. The target population consisted of all active SD/MI and SMP/MTs teachers in West Java. Given the geographic dispersion of

schools across 18 districts and 9 cities, the researchers used non-probability convenience sampling: they distributed a Google Form questionnaire via KKG and MGMP professional networks across multiple districts in June 2026, yielding 238 complete responses. This sample exceeds the 5-10 respondents-per-predictor threshold for regression and meets the $N > 200$ threshold for stable regression estimates in educational survey research (White, 2022).

Participant Profile

A total of 238 teachers completed the questionnaire. The sample was predominantly female (70.2%), taught at the elementary level (SD/MI: 59.2%), worked in public schools (98.3%), and held a Bachelor's degree (90.3%). The largest cohort had more than 20 years of service (34.0%), followed by those with 1-5 years (21.4%), reflecting a heterogeneous sample that spans early-career to senior teachers. This profile broadly represents Indonesia's basic education workforce. **Table 1** presents the full demographic distribution.

Table 1. Participant Demographic Profile

Category	Sub-category	N	%
Gender	Female	167	70.2
	Male	71	29.8
Years of Service	1-5 Years	51	21.4
	6-10 Years	38	16.0
	11-15 Years	26	10.9
	16-20 Years	42	17.6
	>20 Years	81	34.0
	Elementary (SD/MI)	141	59.2
School Level	Junior Secondary (SMP/MTs)	97	40.8
	Public	234	98.3
School Status	Private	4	1.7
	Bachelor's (S1)	215	90.3
Education Level	Master's (S2)	23	9.7

Source: Research 2026

Instrument

A researcher-developed 41-item Likert questionnaire (1 = Strongly Disagree to 5 = Strongly Agree) operationalized four constructs. Transformational Leadership (X1, 12 items) covered the Four Is: Idealized Influence (items 1-3; e.g., "The principal serves as a role model"), Inspirational Motivation (items 4-6), Intellectual Stimulation (items 7-9), and Individualized Consideration (items 10-12; e.g., "The principal provides personal attention to each teacher"), in line with Bass & Avolio (1994) in *Improving Organizational Effectiveness through Transformational Leadership*.

Teacher Motivation (X2, 8 items) covered Intrinsic Motivation (items 13-15), Extrinsic Motivation (items 16-18), and Autonomy and Competence (items 19-20) (Deci & Ryan, 2000). Upskilling and Reskilling (X3, 9 items) covered Upskilling (items 21-23), Reskilling (items 24-26), and Continuous Learning (items 27-29). The 21st-Century Competencies sub-scale (Y) was designed for 12 items covering the six UNESCO (2023) framework domains: Critical Thinking, Creativity and Innovation, Communication, Collaboration, Digital Literacy,

and Adaptability. However, the data-collection platform did not record Instrument Item 30, yielding 11 items (31-41). All analyses are based on 40 recorded items.

Validity, Reliability, and Analysis Procedure

Validity was established via corrected item-total correlation, in which each item's score is correlated with the total score of all remaining items in the same construct. The criterion was $r > r\text{-table} = 0.127$ ($N = 238$; $\alpha = 0.05$). All 40 recorded items met this criterion ($r = 0.456\text{--}0.820$; all $p < .001$). Reliability was confirmed by Cronbach's alpha ($\alpha > 0.60$): $X1 = 0.979$, $X2 = 0.899$, $X3 = 0.945$, $Y = 0.966$. Data analysis proceeded in five sequential stages. First, descriptive statistics (minimum, maximum, mean, SD) characterized each variable. Second, Pearson product-moment correlation examined bivariate associations.

Third, three classical assumption tests were performed: Kolmogorov-Smirnov normality test, VIF-based multicollinearity ($VIF < 10$, $Tolerance > 0.10$), and Breusch-Pagan homoscedasticity, following Field (2018) in *"Discovering Statistics using IBM SPSS Statistics (Vol. 5)"*. Fourth, OLS multiple linear regression ($Y = \alpha + \beta_1 X1 + \beta_2 X2 + \beta_3 X3 + \epsilon$) tested partial effects via t-tests ($H1\text{--}H3$) and the simultaneous effect via F-test ($H4$) at $\alpha = 0.05$. Fifth, we interpreted detected assumption violations as methodological limitations. Standardized beta coefficients (β) were computed to enable direct comparison of each predictor's relative contribution.

RESULTS AND DISCUSSION

This section presents the empirical findings from 238 SD/MI and SMP/MTs teachers in West Java and interprets them in light of the theoretical framework and prior literature. The results are organized sequentially: descriptive statistics characterize each variable's distribution; classical assumption tests establish the validity of the regression inference; Pearson correlations reveal bivariate relationships; and multiple linear regression simultaneously tests the four research hypotheses. Each finding is then discussed in relation to its theoretical implications and practical significance, with direct reference to comparable empirical evidence.

Descriptive Statistics

All four variables recorded very high mean per-item scores on the 5-point scale (**Table 2**). Within Transformational Leadership, *"The principal has high commitment to school progress"* scored highest ($M = 4.63$) and *"The principal provides personal attention to each teacher"* scored lowest ($M = 4.26$), indicating Individualized Consideration is the least consistently enacted dimension. Within Teacher Motivation, the intrinsic item *"I feel that continuing to learn is important"* scored highest ($M = 4.72$), while the obligation-based item *"I develop myself because of job demands"* scored lowest ($M = 4.00$), confirming a predominantly autonomous motivational orientation. Within Upskilling and Reskilling, self-directed skill deepening scored highest ($M = 4.49$) while structured workshop participation was lowest (M

= 4.03). Within 21st-Century Competencies, Collaboration scored highest ($M = 4.60$) and Creativity and Innovation lowest ($M = 4.25$).

Table 2. Descriptive Statistics of Research Variables

Variable	Min	Max	Mean	SD
Transformational Leadership (X1)	12	60	54.61	8.33
Teacher Motivation (X2)	8	40	35.18	5.14
Upskilling and Reskilling (X3)	9	45	38.91	5.70
21st-Century Teacher Competencies (Y)	11	55	48.49	6.86

Source: Research 2026

Classical Assumption Tests

The Kolmogorov-Smirnov test yielded $KS = 0.098$ ($p = .020$), and the Breusch-Pagan test returned $LM = 7.995$ ($p = .046$), indicating mild departures from normality and homoscedasticity attributable to ceiling effects (per-item means of 4.26-4.72 on a 5-point scale). OLS regression coefficients remain unbiased in large samples under these conditions; conventional standard errors may be slightly optimistic and are interpreted accordingly. Multicollinearity was absent: $VIF = 1.796$ (X1), 2.962 (X2), 2.707 (X3); all Tolerance values exceeded 0.10.

Correlation Analysis

All three predictors correlated positively and significantly with Y (all $p < .001$; **Table 3**). Upskilling and Reskilling showed the strongest bivariate association ($r = 0.909$), followed by Teacher Motivation ($r = 0.780$) and Transformational Leadership ($r = 0.641$). The strong X2-X3 correlation ($r = 0.784$) indicates that autonomous motivation is a proximal antecedent of skill-development engagement.

Table 3. Pearson Correlation Matrix

Variable	X1	X2	X3	Y
X1 - Transformational Leadership	1.000	0.647**	0.604**	0.641**
X2 - Teacher Motivation	0.647**	1.000	0.784**	0.780**
X3 - Upskilling and Reskilling	0.604**	0.784**	1.000	0.909**
Y - 21st-Century Competencies	0.641**	0.780**	0.909**	1.000

** $p < .01$ (2-tailed)

Source: Research 2026

Regression Results and Hypothesis Testing

The overall model was highly significant ($F = 423.72$; $p < .001$) and explained 84.5% of variance in 21st-Century Teacher Competencies ($R^2 = 0.845$; Adjusted $R^2 = 0.843$). The regression equation is: $Y = 2.856 + 0.091X1 + 0.165X2 + 0.895X3$.

Table 4. Multiple Linear Regression Results

Model	B	SE	β	t	Sig.
(Constant)	2.856	1.356	-	2.106	.036
Transformational Leadership (X1)	0.091	0.028	0.111	3.208	.002
Teacher Motivation (X2)	0.165	0.059	0.124	2.798	.006
Upskilling and Reskilling (X3)	0.895	0.051	0.745	17.559	.000
$F(3,234) = 423.72, p < .001 \mid R^2 = 0.845 \mid \text{Adjusted } R^2 = 0.843$					

Source: Research 2026

Table 4 presents the multiple linear regression results. As shown, all three predictors exerted statistically significant effects on 21st-Century Teacher Competencies, with Upskilling and Reskilling emerging as the dominant predictor by a substantial margin. H1 is supported: Transformational Leadership exerted a positive and significant partial effect ($\beta = 0.111$; $t = 3.208$; $p = .002$). H2 is supported: Teacher Motivation exerted a positive and significant partial effect ($\beta = 0.124$; $t = 2.798$; $p = .006$). H3 is supported: Upskilling and Reskilling was the overwhelmingly dominant predictor ($\beta = 0.745$; $t = 17.559$; $p < .001$). H4 is supported: the three variables jointly explained 84.5% of the variance ($F = 423.72$; $p < .001$). All four hypotheses are confirmed.

Discussion

Effect of Transformational Leadership

The significant partial effect ($\beta = 0.111$; $p = .002$) confirms that principals' leadership behavior is a meaningful enabling condition for 21st-century competency development, even when controlling for motivation and upskilling-reskilling. Prior research has positioned transformational leadership primarily as a predictor of teacher satisfaction, commitment, and performance (Firmansyah et al., 2022; Kılınc et al., 2024). This study builds on that evidence by showing that its enabling influence extends specifically to 21st-century competency profiles. The relatively modest standardized coefficient ($\beta = 0.111$) reflects leadership's indirect, climate-shaping role rather than a direct competency-production mechanism: structural equation evidence confirms that transformational leadership predicts teacher creativity through professional resilience and job satisfaction as mediators (Kaya, 2024). The lowest item mean within Transformational Leadership (Individualized Consideration, $M = 4.26$) is precisely the dimension most directly linked to individual competency growth, suggesting that strengthening personalized developmental coaching is the highest-leverage leadership action for improving teacher competency outcomes (Bao, 2024; Roesminingsih & Windasari, 2025).

Effect of Teacher Motivation

The significant partial effect ($\beta = 0.124$; $p = .006$) confirms that motivational orientation independently determines competency formation. The divergence within Teacher Motivation, with the intrinsic item ($M = 4.72$) substantially exceeding the obligation-based item ($M = 4.00$), confirms that the sample's motivation is predominantly autonomous, consistent with SDT's prediction that intrinsic motivation most potently sustains professional engagement (Ryan & Deci, 2020). A nationwide latent profile analysis confirmed that teachers with intrinsic motivational profiles engage more deeply in professional development and produce greater competency returns (Richter et al., 2025). The relatively modest β , compared to Upskilling and Reskilling, suggests that motivation functions primarily as an energizing and directing variable: motivated teachers seek out skill-development activities, but those activities produce the competency gains. This dual pathway is corroborated by the strong X2-X3 bivariate correlation ($r = 0.784$) and the finding that motivation retains an

independent direct effect on competency formation even after controlling for upskilling-reskilling engagement (Zhang et al., 2022).

Effect of Upskilling and Reskilling

The overwhelmingly dominant partial effect ($\beta = 0.745$; $t = 17.559$; $p < .001$) is the most consequential finding of this study. The standardized coefficient is nearly seven times larger than that of Transformational Leadership and six times larger than that of Teacher Motivation; the near-linear bivariate correlation ($r = 0.909$) underscores the primacy and directness of this relationship. The practical meaning is unambiguous: of the three enabling, motivating, and operationalizing pillars of teacher competency formation, direct engagement in structured skill-development activities produces the largest observable gain in 21st-century competencies. Continuous skill renewal, encompassing both upskilling of existing capacities and reskilling into new technological and pedagogical domains, must be treated as a non-negotiable structural feature of professional life rather than an episodic activity (Li, 2024).

Comparison with prior findings further highlights the theoretical novelty of this result. Active ongoing skill renewal predicts professional competency formation more strongly than the mere possession of 21st-century skills (Yurt, 2023). The item-level pattern within Upskilling and Reskilling is theoretically significant and practically instructive: independent skill deepening ($M = 4.49$) and new skill acquisition ($M = 4.47$) score high, while structured workshop participation scores lowest ($M = 4.03$). However, structured, collaborative, sustained program-based learning is precisely what higher-order creative and digital pedagogical competencies require to be built reliably (Patre et al., 2023).

The Y-construct finding that Creativity and Innovation scored lowest ($M = 4.25$), while Collaboration scored highest ($M = 4.60$), corroborates this diagnostic: the competency domain most dependent on structured external facilitation is the least developed in this sample. Self-directed skill deepening, while valuable and widespread in this sample, cannot substitute for the external challenge, modeling, and collaborative sense-making that structured professional development programs provide to acquire creative and innovative pedagogical design competencies. This gap reveals a specific, actionable weakness in the current configuration of professional development for Indonesia elementary and junior secondary teachers, one that well-structured institutionalized programs can address (Rachmadtullah et al., 2025).

Simultaneous Effect and Integrated Model

The simultaneous model ($R^2 = 0.845$; $F = 423.72$; $p < .001$) confirms that competency formation is a multi-determined phenomenon. The 84.5% explanatory power substantially exceeds that of paired-variable models in comparable Asian contexts, where leadership alone accounts for 14-38% of variance in teacher performance (Firmansyah et al., 2022). This confirms that the three-variable model captures a significantly more complete picture of competency determinants. The three-layer architecture, in which leadership enables, motivation activates, and upskilling-reskilling delivers, means that interventions targeting only one element are systematically suboptimal (Belay & Melesse, 2024). Indonesian

teachers have strong internal drive and actively invest in self-directed skill development. However, the current modality, skewed toward deepening existing skills rather than acquiring new creative and digital instructional design competencies through structured programs, is insufficient to close the gap required by the Kurikulum Merdeka.

Addressing this gap demands not merely more training but structurally different training: targeted workshops and professional learning communities designed to build creative pedagogical innovation and technology-integrated instruction, embedded within a transformational leadership culture that grants teachers the psychological safety to experiment and innovate (Kaya, 2024; Mikeladze et al., 2024). Several limitations should be considered when interpreting these findings. The non-probability convenience sampling may overrepresent digitally accessible and intrinsically motivated teachers, limiting generalisability beyond the West Java context. All data are self-reported and susceptible to social desirability bias, as reflected in the ceiling-effect score distributions and mild assumption violations detected in the classical assumption tests. The cross-sectional design precludes causal inference; the proposed three-layer model is theoretically grounded but requires longitudinal validation. Additionally, the non-capture of Instrument Item 30 reduced the 21st-Century Competencies construct from 12 to 11 items, which may marginally affect construct coverage.

CONCLUSION

All four hypotheses were supported. Transformational Leadership exerts a significant positive effect, confirming its role as a structural enabling condition that creates the professional climate for competency development. Teacher Motivation exerts a significant independent positive effect, establishing autonomous motivational orientation as a distinct psychological driver of competency formation that operates beyond its indirect pathway through skill-development activities. Upskilling and reskilling emerge as the overwhelmingly dominant predictor, showing that structured, active, and continuous skill renewal is the most direct mechanism for forming 21st-century teacher competencies. The simultaneous model confirms that competency formation is multi-determined: leadership enables, motivation activates, and upskilling-reskilling delivers, constituting an integrated causal sequence in which all three components are independently necessary.

Future research should extend the model to upper-secondary and vocational school levels to test whether Upskilling and Reskilling's dominance as a predictor is consistent across school types. Longitudinal or quasi-experimental designs are also recommended to establish causal direction. Future work should further incorporate potential mediating and moderating variables, including school organizational climate, teacher self-efficacy, and digital infrastructure availability, to develop a more comprehensive explanatory model. Additionally, Instrument Item 30 should be restored, the complete instrument revalidated, and heteroscedasticity-consistent standard errors should be applied to address the detected assumption violations.

AUTHOR'S NOTE

The author declares that there is no conflict of interest regarding the publication of this article. The author affirms that the article's data and content are free from plagiarism.

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