Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

University teachers' artificial intelligence use, perceived organizational support, and professional identification: Their structural relations with autonomous work motivation, work engagement, and innovative work behavior

Qiuping Xie
Hezhou University
Pratuang Phumpatrakom
International College, Rattana Bundit University
Hongye Lu
Baise University
Youjie Hua
201904001@hzxy.edu.cn

Hezhou University

Article

Keywords: artificial intelligence use, perceived organizational support, professional identification, autonomous work motivation, work engagement, innovative work behavior

Posted Date: November 4th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11360955/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

University teachers' artificial intelligence use, perceived organizational support, and professional identification: Their structural relations with autonomous work motivation, work engagement, and innovative work behavior

Qiuping Xie[1,2], Pratuang Phumpatrakom[2], Hongye Lu[3] and Youjie Hua[1*]

1 School of Foreign Languages, Hezhou University, Hezhou 542899, China

2 International College, Rattana Bundit University, Bangkok 10110, Thailand

3 Development Planning Center, Baise University, Baise 533000, China

* Corresponding author: Youjie Hua; Email: 201904001@hzxy.edu.cn

Abstract

Background The availability of artificial intelligence does not explain why some teachers translate technological opportunities into innovative practice. Drawing on self-determination theory and job demands–resources theory, this study examines autonomous work motivation and work engagement as parallel mediators linking artificial intelligence use, perceived organizational support, and professional identification with innovative work behavior.

Methods Survey responses from 508 university teachers in China were matched across three occasions approximately four weeks apart and analyzed using latent-variable modeling with bootstrap inference.

Results The findings support distinct indirect associations through teachers' autonomous reasons for working and their energetic involvement in work. Both mediators remained relevant to subsequent innovation when considered together, although their relative strength could not be established. The total association between artificial intelligence use and innovation remained uncertain, whereas organizational support and professional identification showed positive total associations. These patterns qualify an account of innovation centered on technological use alone and place teachers' institutional experiences and professional commitments within the same explanatory model. By extending the outcome beyond engagement, the study identifies motivational relationships associated with later innovative activity while distinguishing endorsement of work from investment in it.

Conclusions The findings suggest that university initiatives should attend to professional discretion and supportive working conditions alongside access to technology. The observational design supports an account of temporally ordered associations rather than causal mediation.

Keywords artificial intelligence use; perceived organizational support; professional identification; autonomous work motivation; work engagement; innovative work behavior

Background

Artificial intelligence (AI) has enlarged the range of tools available to university teachers, but using a new tool and developing an educational innovation are different accomplishments. A teacher may generate lesson materials rapidly without changing an established practice; another may use AI selectively while developing, promoting, and implementing a new approach to assessment. Innovative work behavior concerns this broader process of bringing ideas into practice [1, 2]. The distinction directs attention from access to technology toward the conditions under which teachers are willing and able to pursue improvement.

Research on AI in higher education has moved from documenting applications toward examining their educational and human implications. Zawacki-Richter et al. [3] questioned the limited visibility of educators in the earlier evidence base. Crompton and Burke [4] subsequently identified a broader research field, although student applications continued to predominate. Reviews by Chiu et al. [5] and Bond et al. [6] further underline the need for stronger contextual and conceptual grounding. For research on teachers, this means explaining how AI use enters an existing professional activity rather than treating adoption as a sufficient indicator of educational improvement.

Evidence from other occupations illustrates why such an explanation is needed. AI assistance has improved performance on professional writing tasks and in customer support, with benefits differing across workers [7, 8]. Yet improvements in individual creative output can coexist with reduced diversity across outputs [9]. These findings establish possibilities rather than a uniform relationship between use and innovation. In university teaching, the effort required to evaluate an idea, secure colleagues' cooperation, and sustain implementation may depend as much on teachers' experience of work as on the capabilities of the application.

Moreira-Fontán et al. [10] provide a useful starting point. Their account of secondary-school teachers connected ICT-related self-efficacy, job resources, and positive emotions with autonomous motivation and work engagement. It treated technological experience as part of a wider psychological setting and placed engagement at the end of the explanatory model. Two questions remain when this approach is extended to AI-related academic work: whether reported technology use, rather than confidence in using ICT, is associated with these motivational experiences, and whether motivation and engagement each help explain subsequent innovative behavior. The latter question matters because willing endorsement of work and energetic involvement in it need not contribute identically to innovation.

Recent teacher research begins to address this terrain. Gai et al. [11] associated AI use with innovative work behavior through meaningfulness and creative self-efficacy, while Wu [12] examined professional identity and other psychological processes in AI-supported university teachers' engagement. These studies identify relevant experiences but do not make autonomous motivation, engagement, meaningfulness, and efficacy interchangeable. Believing that an activity is significant or that one can perform it successfully differs from choosing to invest in it and sustaining that investment.

Examining autonomous motivation and engagement jointly therefore permits a more specific assessment of how teachers' work experiences relate to innovation.

The present model brings AI use together with perceived organizational support and professional identification. Self-determination theory (SDT) explains the quality of teachers' reasons for acting, while job demands–resources (JD-R) theory explains the motivational significance of their working conditions [13, 14]. Organizational support represents the perceived institutional context; professional identification concerns teachers' attachment to their occupation. Assessing these predictors together avoids attributing every favorable work experience to technology. Using measurements separated by approximately four weeks, we examine whether autonomous work motivation and work engagement provide distinct indirect links with innovative behavior at the final survey. The contribution is a joint account of technological practice, institutional support, and professional self-definition in relation to later innovation, with the two motivational pathways estimated without imposing a sequence between them.

Theoretical background and hypotheses

The proposed model treats artificial intelligence use, perceived organizational support, and professional identification as independent variables, autonomous work motivation and work engagement as parallel mediators, and innovative work behavior as the dependent variable. These roles distinguish a technological practice, a perception of the institution, and an attachment to the profession from the motivational experiences through which they may relate to behavior. SDT explains the endorsement of work goals, whereas JD-R theory explains how resources support sustained involvement [14, 15]. Their integration provides a basis for examining the antecedents together without assuming that motivation and engagement are interchangeable.

Artificial intelligence use

AI use refers here to teachers' reported incorporation of AI into their work. It differs from AI literacy, trust in AI, and perceived technological competence, each of which may influence how an application is used. Kasneci et al. [16] describe educational opportunities associated with large language models alongside the demands of evaluating their outputs. Glikson and Woolley [17] show that trust depends on features of the technology and the interaction context. In a teacher-focused study, Nazaretsky et al. [18] found that explanations of AI decisions and its complementary role could improve teachers' trust. These contributions place use within a professional judgment process; they do not warrant assuming that frequent use itself represents skilled or beneficial integration.

Organizational studies likewise resist a simple resource interpretation. Raisch and Krakowski [19] argue that automation and augmentation are interdependent, while Parker and Grote [20] locate technological consequences in changes to work design. Tang et al. [21] demonstrate that the implications of working with intelligent machines depend on employee characteristics, and He et al. [22] identify mixed consequences of leaders' AI-oriented change behavior. AI may make

exploration easier, but it can also introduce checking demands, alter discretion, or increase performance expectations. Its motivational role must therefore be examined rather than built into the definition of the predictor.

Empirical work provides grounds for treating AI use as an antecedent while also identifying what remains unexplained. Gai et al. [11] modeled AI use as a predictor of teachers' innovative work behavior through work meaningfulness and creative self-efficacy. Their account concerns the significance of work and confidence in creative capability. Autonomous motivation instead concerns the reasons teachers endorse their work, and engagement concerns their experienced involvement. These distinctions matter because a teacher may recognize the value of AI or feel capable of using it without willingly investing in a particular educational change. Experimental writing evidence and field evidence from customer support show that AI assistance can expand what workers accomplish, although neither establishes the motivational process underlying teacher innovation [7, 8].

The proposed positive relationships follow from the opportunities AI may offer to pursue personally valued ideas and reduce burdens competing for attention. Within SDT, the relevant connection is to willing engagement in meaningful work; within JD-R theory, it is to the energy and involvement that usable resources may support [15, 23]. We therefore examine AI use as an independent variable associated with both autonomous work motivation and work engagement, rather than treating use as evidence that either state has already been achieved.

H1a–H1b. AI use is positively associated with autonomous work motivation (H1a) and work engagement (H1b).

Perceived organizational support

Perceived organizational support concerns employees' general belief that their organization values their contribution and cares about their well-being [24]. It is broader than access to equipment or assistance with a particular innovation. Rhoades and Eisenberger [25] linked this perception to treatment by the organization and its representatives; Kurtessis et al. [26] subsequently found extensive meta-analytic support for its connections with work orientations, performance, and well-being. Organizational support theory explains these relationships through social exchange, attribution, and socioemotional processes [27]. For university teachers, support may matter when an initiative involves uncertain outcomes and effort that is not immediately rewarded.

The connection with autonomous motivation requires more than a reciprocity argument. Feeling obliged to repay an institution is not equivalent to valuing an activity for oneself. SDT proposes that work environments can facilitate the internalization of goals when employees experience acknowledgment, competence, and choice [28]. General support is not identical to autonomy support, but recognition and care may help make institutional goals personally acceptable. Lam et al. [29] found that support for teachers' competence, autonomy, and collegiality was related to motivation and willingness to persist in project-based learning. Their evidence suggests a motivational route from supportive conditions to educational change, while leaving open whether a general perception of institutional support carries a similar relationship.

Research has also positioned perceived organizational support as an antecedent of engagement. Saks [30] examined support in relation to job and organization engagement, while Rich et al. [31] included it among the antecedents of engagement in a performance model. In AI-supported higher education, Wu [12] treated organizational support as a predictor and professional identity, resilience, and self-efficacy as mediating personal resources. These studies differ in how they define engagement and specify its intervening processes, but converge on the relevance of employees' experience of institutional support. Hakanen et al. [32] connected teachers' job resources with engagement, and Moreira-Fontán et al. [10] examined support specifically for innovation. The present model extends this conversation by testing general perceived support as an independent predictor of both autonomous motivation and engagement, alongside AI use and professional identification.

H2a–H2b. Perceived organizational support is positively associated with autonomous work motivation (H2a) and work engagement (H2b).

Professional identification

Professional identification concerns the extent to which membership in the teaching profession forms part of a person's self-definition. Identification scholarship distinguishes attachment to a collective from evaluations of what that collective provides [33, 34]. This distinction is particularly relevant in universities: a teacher may identify strongly with the profession while regarding the employing institution as unsupportive. Professional identification and organizational support can therefore covary without representing the same psychological experience.

Teacher identity research gives this argument a richer context. Beijaard et al. [35] describe professional identity as an ongoing interpretation of experience within professional settings. Beauchamp and Thomas [36] emphasize the roles of agency, reflection, and context in that development. The identification construct examined here is narrower: it addresses attachment to professional membership rather than the full narrative or developmental organization of a teacher's identity. Research on school teachers by van Dick and Wagner [37] also distinguishes the foci and dimensions of social identification. That work cautions against treating identification with a profession, a work group, and an employer as equivalent predictors.

The case for professional identification as an independent variable follows from the personal relevance of professional goals. When teaching is integral to self-definition, improving a practice may express a valued commitment. Canrinus et al. [38] connected motivation, commitment, satisfaction, and efficacy within teachers' professional identity, treating these as identity-related indicators rather than the separate constructs examined here. Wu [12] positioned professional identity as a mediator between contextual resources and engagement in AI-supported higher education. That ordering shows one role identity can occupy; it does not rule out examining professional identification as an earlier correlate of motivational experience. By separating membership-based identification from autonomous work motivation and engagement, the present model tests whether it contributes to each after perceived support and AI use are taken into account.

Identification does not imply uncritical acceptance of institutional change. A professionally committed teacher may question an AI application precisely because its use appears inconsistent with educational responsibilities. The proposed positive relationships concern willingness and energy directed toward work, not compliance with every technology initiative. This qualification makes professional identification a theoretically distinct predictor alongside AI use and perceived support.

H3a–H3b. Professional identification is positively associated with autonomous work motivation (H3a) and work engagement (H3b).

Autonomous work motivation

Autonomous motivation describes acting with a sense of volition, either because an activity is interesting or because its value has been personally endorsed. SDT distinguishes these reasons from action sustained by external demands or internal pressure [15, 39]. Identified regulation is consequential for teaching: revising an assessment procedure or persuading colleagues to trial a new approach may be demanding without being enjoyable, yet remain autonomously motivated. The distinction concerns why effort is invested, not simply how much effort is visible.

Research on work motivation supports retaining this qualitative distinction. The Multidimensional Work Motivation Scale separates intrinsic motivation and identified regulation from controlled forms of motivation [40]. Van den Broeck et al. [41] show that these regulations have different relationships with work outcomes, while Cerasoli et al. [42] link intrinsic motivation particularly to performance quality. Fernet et al. [43] further demonstrate the value of assessing teachers' motivation toward specific work tasks. A teacher can thus approach different parts of the same job for different reasons, making broad work motivation informative but not exhaustive.

Autonomous motivation has been examined as an intervening process linking work conditions with employee functioning. Fernet et al. [44] investigated motivational processes in the relationships of transformational leadership and perceived job characteristics with work outcomes; Lam et al. [29] connected school support with persistence through teacher motivation. Gorozidis and Papaioannou [45] found that autonomous, but not controlled, motivation predicted teachers' intentions to participate in training and implement innovations. Together, these studies support its mediating role while leaving a distinction between intending to innovate and reporting innovative activity. The present study examines autonomous work motivation as a mediator of the relationships linking each of the three antecedents with innovative work behavior, while accounting for engagement in the same model.

Technological change makes the quality of work motivation particularly relevant. Gagné et al. [46] argue that changes in work should be understood through their implications for psychological needs and self-determination. AI use, institutional support, and professional identification offer different possible connections to the endorsement of work goals: opportunities to pursue a task, the experience of being valued, and the importance of acting as a teacher. The proposed mediation

concerns their association with autonomous reasons for working, not an assumption that all three satisfy the same need. Joint estimation with engagement asks whether those reasons retain relevance beyond the intensity of work involvement.

Work engagement

Work engagement is a positive work-related state characterized by vigor, dedication, and absorption [47, 48]. It describes teachers' experience while working rather than the reasons that make the activity worth undertaking. An educational goal may be willingly endorsed even when a teacher lacks the energy to pursue it; conversely, intense involvement does not establish that the activity is freely chosen. Treating engagement and autonomous motivation separately therefore preserves a distinction between motivational quality and experienced investment.

JD-R theory places engagement within a motivational process linking job resources with work outcomes [14]. Teacher studies support the relevance of this account. Hakanen et al. [32] identified engagement as part of the relationship between working conditions and organizational commitment. Bakker and Bal [49] showed that weekly resources and engagement were related to weekly performance among beginning teachers. At a broader occupational level, Christian et al. [50] found meta-analytic support for engagement's role between antecedents and performance. These findings make engagement a credible mediator, but also show why its relevance should be tested for a particular outcome rather than inferred from positive job attitudes generally.

Engagement has also been connected specifically with innovation. Hakanen et al. [51] linked resources, engagement, personal initiative, and work-unit innovativeness in a longitudinal account of resource gains. Kwon and Kim [52] integrated engagement and innovative behavior within JD-R theory, while Gupta and Sikarwar [53] examined personal engagement as a pathway from ethical leadership to innovative work behavior in hospitality. Work-unit innovativeness and personal engagement differ from the individual behavioral outcome and UWES construct used here. Their convergence nevertheless supports testing engagement as a mediator between work-related antecedents and teachers' own innovative activity. This role extends the endpoint beyond feeling engaged to the behavior associated with that involvement.

The role assigned to engagement also distinguishes the present model from Moreira-Fontán et al. [10], who treated it as the outcome of relationships involving autonomous motivation. Here, engagement is a mediator and innovative work behavior is the final outcome. Xanthopoulou et al. [54] reported reciprocal relationships between resources and engagement, and Bakker and Bal [49] found that engagement was related to subsequent weekly resources. Such findings caution against treating one proposed ordering as definitive. Because the two mediators were measured together in this study, they are modeled in parallel with correlated disturbances; no direction between motivation and engagement is imposed.

Innovative work behavior

Innovative work behavior encompasses generating ideas, promoting them, and realizing them in practice [1]. It extends beyond creativity understood as producing novel and useful ideas, although the processes are closely connected [2]. Scott and Bruce [55] located individual innovative behavior within relationships among leadership, problem-solving approaches,

and the work environment. Subsequent measurement work by De Jong and Den Hartog [56] emphasized the movement from exploration to implementation while also noting the difficulty of separating these activities empirically. A broad behavioral outcome is therefore appropriate for examining teachers' overall innovative activity, provided that the analysis does not infer unmeasured differences between its stages.

As a dependent variable, innovative work behavior has been explained through both personal and contextual antecedents. Scott and Bruce [55] situated individual innovation within leadership and the work environment; Hammond et al. [57] synthesized its individual-level predictors; and Thurlings et al. [58] integrated individual and environmental conditions in a teacher-focused review. Gai et al. [11] subsequently used innovative work behavior as the outcome of an AI-use model. These contributions justify examining innovation as a behavioral endpoint influenced by more than technological practice alone. Assessing AI use, perceived organizational support, and professional identification together locates that endpoint within teachers' professional work, while the two mediators specify distinguishable motivational pathways to it.

Autonomous motivation and engagement offer different reasons to expect sustained innovative activity. Personally endorsed goals may make the uncertainties of experimentation worth accepting; vigor and dedication may help a teacher continue through revisions and resistance. The evidence linking autonomous motivation with innovation intentions and engagement with performance makes both relationships plausible [45, 50]. Their joint estimation asks whether either association disappears when the other is included. It also extends the engagement outcome of Moreira-Fontán et al. [10] toward subsequent behavior.

H4a–H4b. Autonomous work motivation (H4a) and work engagement (H4b) are positively associated with innovative work behavior.

These arguments imply indirect relationships from the three antecedents to innovation through each motivational state. Such relationships represent a specific empirical extension of resource and motivation research: technological practice, institutional experience, and professional membership are assessed together, and their associations with innovation are decomposed into two distinguishable pathways. Direct antecedent-to-innovation paths are retained in the estimated model so that the proposed pathways need not account for every association. Figure 1 presents the research framework and directional hypotheses.

H5a–H5f. AI use, perceived organizational support, and professional identification have positive indirect associations with innovative work behavior through autonomous work motivation and work engagement. The pathways are AI use → autonomous work motivation → innovative work behavior (H5a), AI use → work engagement → innovative work behavior (H5b), organizational support → autonomous work motivation → innovative work behavior (H5c), organizational support → work engagement → innovative work behavior (H5d), professional identification → autonomous work motivation → innovative work behavior (H5e), and professional identification → work engagement → innovative work behavior (H5f).

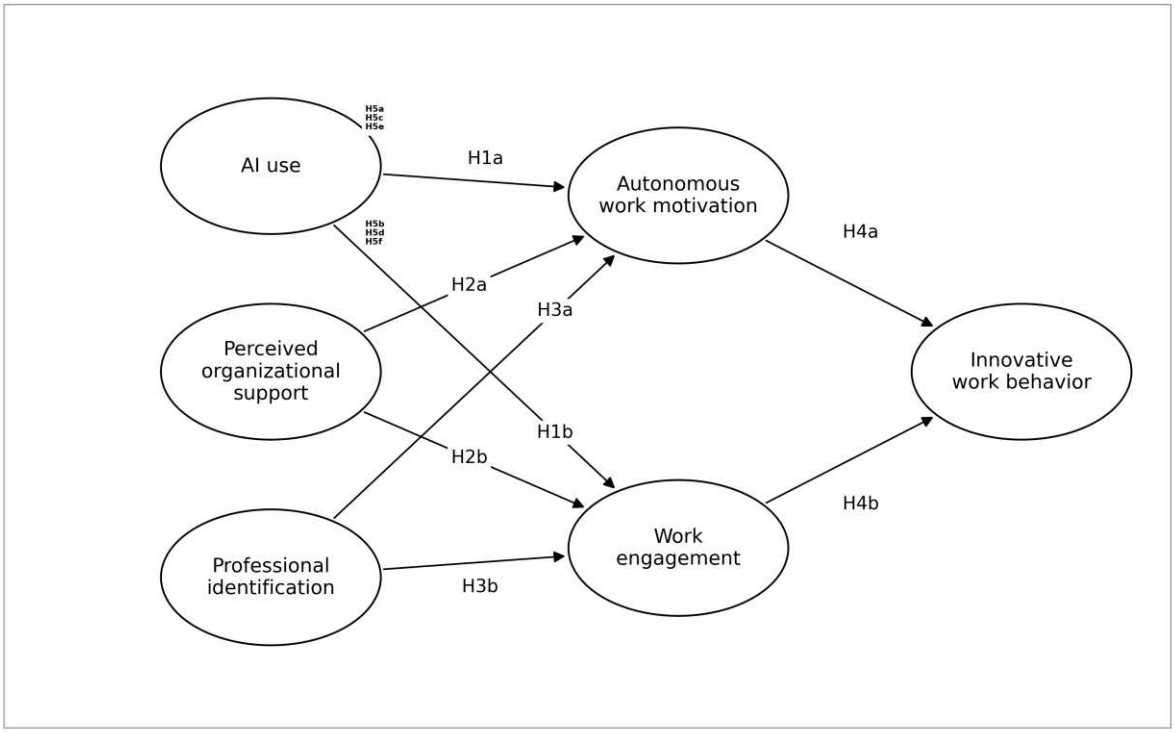


Fig. 1 Research framework and hypothesized paths

Arrows identify H1a–H4b. H5a–H5f denote the six indirect pathways from the three antecedents through autonomous work motivation or work engagement to innovative work behavior. The fitted specification additionally retains all three direct antecedent-to-outcome paths and freely estimates predictor covariances and the mediator disturbance covariance.

Methods

A three-occasion survey design separated the assessment of the antecedents, mediators, and outcome. The analyses used teachers' responses matched across all three occasions.

Participants

Participants were university teachers in China with active teaching responsibilities. The final analytic sample comprised 508 teachers who completed all three questionnaires. Their teaching experience averaged 8.05 years (SD = 5.21; range = 1–26). The background records also included gender, academic rank, and prior AI training. Comparisons across the available survey records indicated broadly similar baseline profiles, although teachers retained to the final survey had somewhat higher engagement at the preceding survey than those subsequently lost to follow-up.

Instruments

The questionnaire comprised 36 items drawn from published measures. Response formats differed across instruments; descriptive means are therefore interpreted within each measure's own metric.

Artificial intelligence use was assessed with three items adapted from Tang et al.'s [21] measure of AI use at work. Responses used a seven-point agreement scale coded from 1 to 7.

Perceived organizational support was measured using the three-item short form of the Survey of Perceived Organizational Support (SPOS) used in Study 1 of Eisenberger et al. [59], derived from the original SPOS developed by Eisenberger et al. [24]. The items concern feeling valued and cared for by the employing university. Responses used a five-point agreement scale (1–5).

Professional identification was operationalized with six items adapted from Mael and Ashforth's [33] organizational identification scale. The referent was changed from the organization to the university teaching profession to capture identification with professional membership. Responses used a five-point agreement format (1–5).

Autonomous work motivation was assessed using the intrinsic motivation and identified regulation subscales of the Multidimensional Work Motivation Scale (MWMS; [40]). Each contributed three items, reflecting enjoyment of work and its personally endorsed value, respectively. Teachers rated how closely these reasons corresponded to their work motivation on a seven-point scale (1–7).

Work engagement was measured with the nine-item Utrecht Work Engagement Scale (UWES-9), validated by Schaufeli et al. [48]. Three items each assess vigor, dedication, and absorption. Responses used a seven-category frequency scale coded from 0 to 6.

Innovative work behavior was assessed with Janssen's [1] nine-item measure, comprising three items each for idea generation, idea promotion, and idea realization. Teachers reported the frequency of these behaviors on a seven-point scale (1–7).

Individual items served as latent-factor indicators. Autonomous work motivation, work engagement, and innovative work behavior were each represented by a broad first-order factor.

Procedure

Data collection proceeded in three stages at intervals of approximately four weeks, spanning approximately eight weeks from the first to the final survey. The first survey (T1) assessed artificial intelligence use, perceived organizational support, professional identification, and background characteristics. Approximately four weeks later, the second survey (T2) measured autonomous work motivation and work engagement. The third survey (T3), administered after a further interval of approximately four weeks, assessed innovative work behavior. Recorded participation decreased from 750 to 640 and then 508, corresponding to 67.7% retention from the first to the final survey.

Responses were linked using participant identification codes, which were unique within each survey. All 508 final-survey respondents were matched to both earlier surveys without discrepancies. Their records contained complete responses to all 36 focal items, with no out-of-range values; no additional cases were removed. Because each construct was assessed only once, this procedure established an order of measurement rather than repeated observations of change in the same constructs.

Data analyses

Following the two-step approach of Anderson and Gerbing [60], we evaluated the measurement model before interpreting structural relationships. A six-factor confirmatory factor analysis (CFA) specified 36 reflective indicators, each loading on its designated construct, with the first unstandardized loading of each factor fixed to 1. Cross-loadings and correlated item errors were excluded. A five-factor alternative combined autonomous motivation and engagement; a one-factor alternative combined all items. These comparisons assessed construct differentiation rather than the absence of common method bias.

Gaussian maximum likelihood estimation treated items as continuous, with N−1 used for covariance and likelihood-ratio scaling. Measurement assessment included standardized loadings, Cronbach's alpha, composite reliability (CR), average variance extracted (AVE), and heterotrait–monotrait ratios (HTMT; [61, 62]). Model fit was evaluated using χ^2, CFI, TLI, RMSEA with its 90% confidence interval, and SRMR, considering conventional criteria as guides rather than definitive decision rules [63].

The structural model estimated six antecedent-to-mediator paths, two mediator-to-innovation paths, and three direct antecedent-to-innovation paths. Antecedents were freely correlated, as were the disturbances of the two mediators. No directional path connected the mediators. Background characteristics and institution-level clustering were not included in the structural specification. A nested alternative fixed their disturbance covariance to zero. With all direct paths retained and mediator disturbances correlated, the primary latent structural model is an exact regression reparameterization of the correlated-factor CFA. It therefore has identical fit and degrees of freedom; global fit evaluates the measurement restrictions rather than independently confirming the proposed temporal ordering.

Specific indirect associations were calculated as products of constituent paths. Their sums gave total indirect associations; adding the relevant direct coefficient gave each total association. Inference used 5,000 nonparametric bootstrap resamples of teachers, retaining each teacher's complete record across occasions and re-estimating the measurement and structural parameters in every replication. All replications converged and were admissible. Bias-corrected 95% intervals without acceleration were calculated for standardized indirect associations, total associations, and contrasts between the two indirect pathways [64]. Structural-path standard errors were empirical bootstrap standard deviations, and two-sided Wald p values used the unstandardized estimates. The random seed was 20261005. An interval excluding zero supported the specified association; a significant total association was not required to test an indirect pathway [65].

Results

Construct differentiation

Table 1 reports descriptive statistics, correlations, and reliability for the 508 teachers retained at T3, using their responses from the designated measurement occasions. Scale-score correlations were positive. Cronbach's alpha ranged from .835 to .922, CR from .837 to .923, and AVE from .540 to .662. The six-factor CFA fitted the data well, $\chi^2(579) = 629.965$, $p = .070$, CFI = .995, TLI = .994, RMSEA = .013, 90% CI [.000, .020], and SRMR = .028. Standardized loadings ranged from

.661 to .854; all freely estimated loadings were significant at $p < .001$. Figure 2 displays the item-level measurement model.

Table 1 Bivariate correlations, descriptive statistics, and reliability indices

Construct / statistic	1	2	3	4	5	6
1. AI use	—					
2. Organizational support	.248	—				
3. Professional identification	.202	.299	—			
4. Autonomous motivation	.330	.300	.321	—		
5. Work engagement	.326	.360	.377	.501	—	
6. Innovative behavior	.158	.198	.186	.347	.391	—
Mean	4.29	3.32	3.59	4.89	3.95	4.52
SD	1.44	0.97	0.89	1.33	1.22	1.24
Skewness	−.36	−.19	−.53	−.66	−.59	−.51
Excess kurtosis	−.60	−.79	−.41	−.27	−.17	−.32
Cronbach's α	.853	.835	.893	.906	.913	.922
CR	.854	.837	.893	.906	.913	.923
AVE	.662	.633	.582	.617	.540	.570

N = 508. All correlations: $p < .001$. Descriptive statistics refer to item-mean scale scores; kurtosis is excess kurtosis. CR = composite reliability; AVE = average variance extracted. Response ranges: AIU, AWM, IWB = 1–7; POS, PI = 1–5; WE = 0–6. Absolute means across different instruments are not directly comparable.

Combining autonomous motivation and engagement into one factor substantially reduced fit, as did the one-factor model (Table 2). The largest HTMT ratio was .551, between the two mediators. These findings support distinguishing the six broad constructs and, in particular, considering motivation and engagement separately when explaining the final innovation outcome. They do not establish that finer component structures or shared method effects can be disregarded.

Table 2 Fit of the six-factor model and specification alternatives

Model	χ^2	df	p	CFI	TLI	RMSEA	90% CI	SRMR
Six-factor CFA	629.965	579	.070	.995	.994	.013	[.000, .020]	.028
Primary SEM	629.965	579	.070	.995	.994	.013	[.000, .020]	.028
SEM with zero mediator covariance	688.363	580	.001	.989	.988	.019	[.013, .025]	.054
Five-factor CFA	1736.281	584	< .001	.885	.876	.062	[.059, .066]	.057
One-factor CFA	5832.400	594	< .001	.476	.444	.132	[.129, .135]	.133

The CFA and primary SEM are equivalent covariance parameterizations. Primary SEM freely estimates the mediator disturbance covariance. The five-factor model combines AWM and WE; the one-factor model combines all 36 items. CFI = comparative fit index; TLI = Tucker–Lewis index; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual.

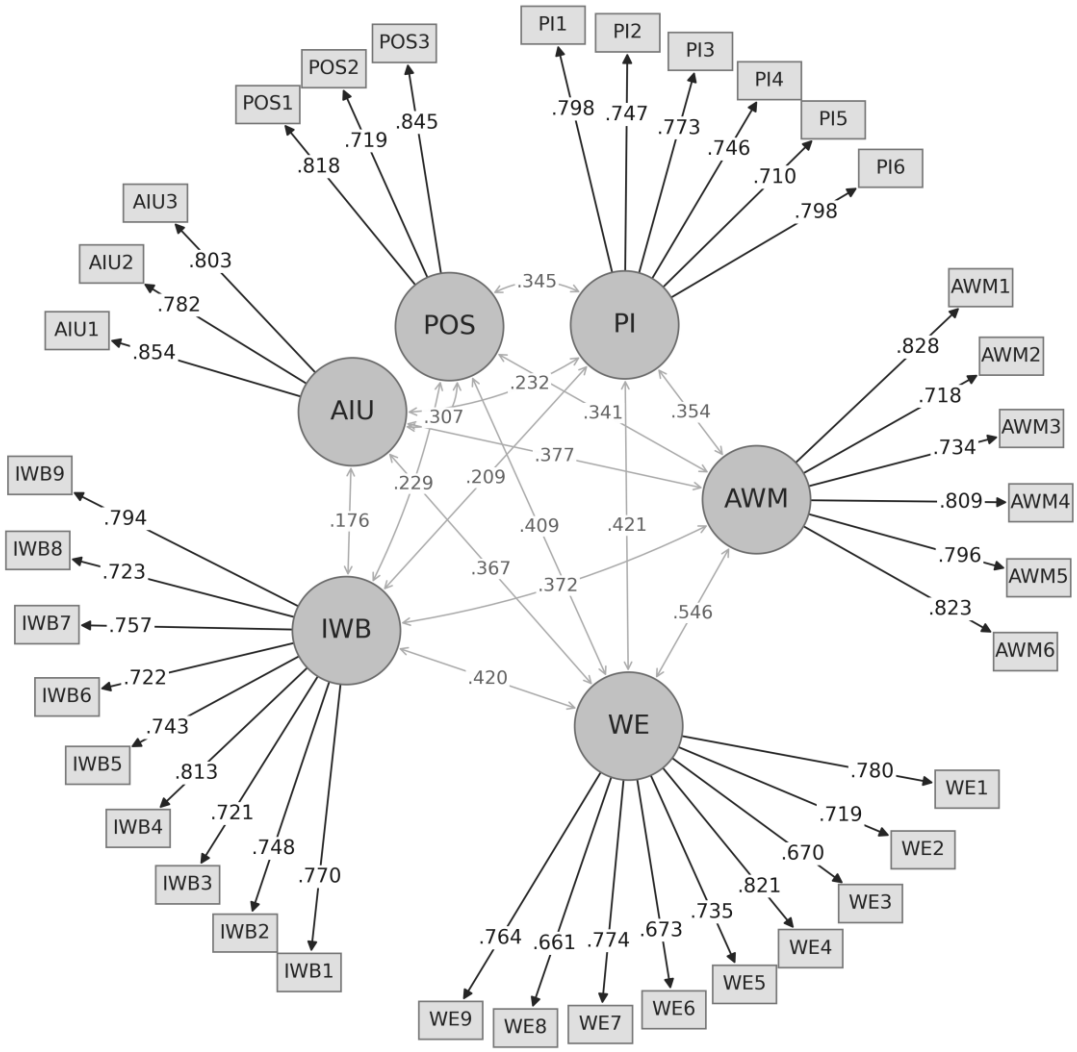


Fig. 2 Six-factor measurement model

Single-headed arrows show standardized item loadings; gray double-headed arrows show latent-factor correlations. Item residuals are omitted for clarity.

Structural associations

The primary structural model shared the fit of the six-factor CFA. The mediator disturbance correlation was .381, with a bias-corrected 95% CI [.288, .478]. Constraining this covariance to zero worsened fit, $\Delta\chi^2(1) = 58.398$, $p < .001$ (Table 2). Accordingly, the reported paths come from the model that allows autonomous motivation and engagement to share unexplained variation.

All three antecedents were positively associated with both motivational states (Table 3), supporting H1a–H3b. For AI use, the standardized paths were .268 to autonomous motivation and .227 to engagement. Corresponding estimates were .179 and .242 for organizational support, and .230 and .285 for professional identification. Each was significant at $p < .001$. The model explained 24.4% of the variance in autonomous motivation and 30.2% in engagement.

Table 3 Structural paths and tests of the directional hypotheses

Hypothesis	Path	B	Boot SE	β	p	Supported
H1a	AIU → AWM	.260	.052	.268	< .001	Yes
H1b	AIU → WE	.198	.043	.227	< .001	Yes
H2a	POS → AWM	.274	.082	.179	< .001	Yes
H2b	POS → WE	.332	.070	.242	< .001	Yes
H3a	PI → AWM	.354	.076	.230	< .001	Yes
H3b	PI → WE	.395	.074	.285	< .001	Yes
H4a	AWM → IWB	.195	.054	.201	< .001	Yes
H4b	WE → IWB	.325	.068	.301	< .001	Yes

B = unstandardized coefficient; β = standardized coefficient. Bootstrap SE refers to B. Two-sided Wald p values use B/SE. All bootstrap analyses use 5,000 teacher-level resamples. AIU = AI use; POS = perceived organizational support; PI = professional identification; AWM = autonomous work motivation; WE = work engagement; IWB = innovative work behavior.

The central outcome was innovative work behavior at T3. Autonomous motivation (β = .201) and engagement (β = .301) each retained a positive association with this outcome after adjustment for the other mediator and all three antecedents (both $p < .001$), supporting H4a and H4b. Together, the modeled predictors explained 20.7% of its variance. None of the conditional direct antecedent-to-innovation paths was significant: AI use, β = −.023, p = .652; organizational support, β = .043, p = .429; and professional identification, β = .002, p = .973. Figure 3 distinguishes these paths from the supported directional relationships.

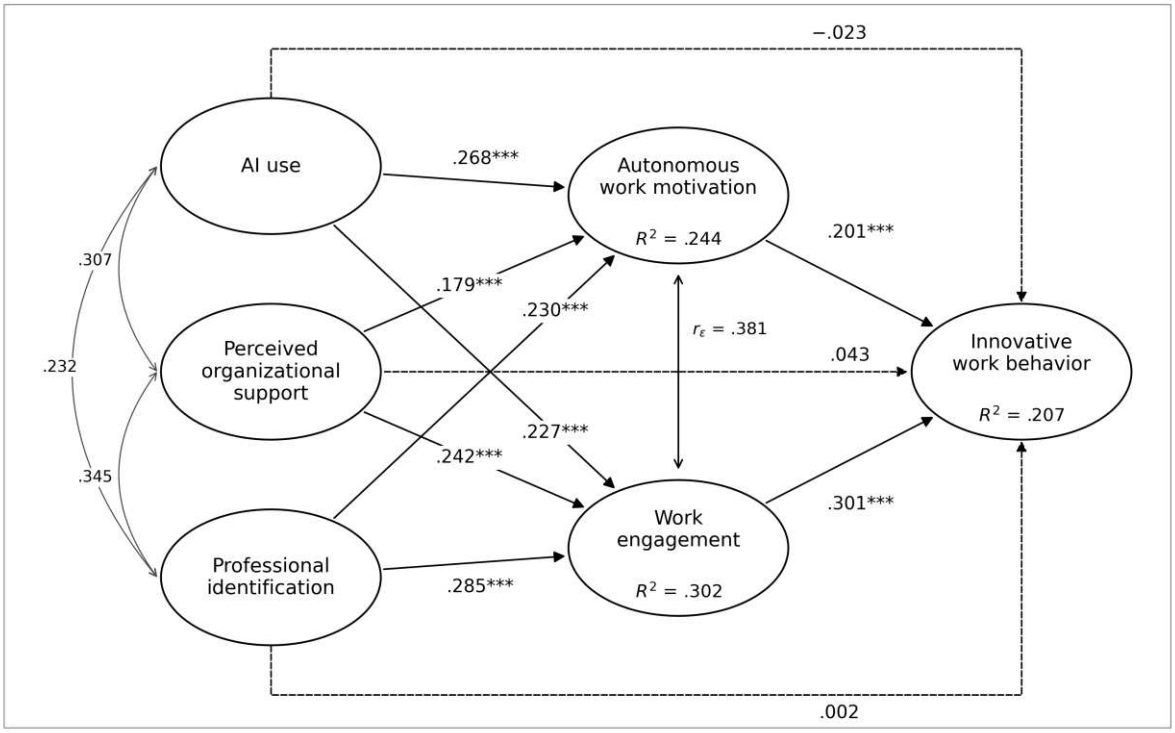


Fig. 3 Structural model with standardized estimates

Solid directional paths: p < .001 (***); dashed paths: p > .05. R^2 is shown for each endogenous factor. Curved arrows on the left represent predictor correlations; rε denotes the correlation between mediator disturbances. Observed indicators are omitted for clarity.

Indirect pathways to innovation

All six specific indirect associations with T3 innovative behavior were positive, with bias-corrected intervals excluding zero (Table 4), supporting H5a–H5f. AI use showed indirect associations of .054 through autonomous motivation and .068 through engagement. The corresponding estimates were .036 and .073 for organizational support, and .046 and .086 for professional identification. Thus, each antecedent was associated with innovation through both motivational states in the same model.

Table 4 Specific indirect associations and tests of H5a–H5f

Hypothesis	Predictor	Mediator	Criterion	β	95% BC CI	Supported
H5a	AIU	AWM	IWB	.054	[.024, .097]	Yes
H5b	AIU	WE	IWB	.068	[.036, .114]	Yes
H5c	POS	AWM	IWB	.036	[.014, .073]	Yes
H5d	POS	WE	IWB	.073	[.039, .121]	Yes
H5e	PI	AWM	IWB	.046	[.020, .085]	Yes
H5f	PI	WE	IWB	.086	[.045, .141]	Yes

All six 95% BC intervals exclude zero. Support concerns the specified indirect association; it does not establish causal or complete mediation. The two mediators were measured together and modeled in parallel.

Table 5 summarizes the hypothesis tests and distinguishes direct, indirect, and total associations. Total indirect associations with innovation were positive for AI use, β = .122, 95% BC CI [.077, .176]; organizational support, β = .109, 95% BC CI [.065, .164]; and professional identification, β = .132, 95% BC CI [.087, .193]. Total associations were positive for organizational support, β = .152, 95% BC CI [.042, .261], and professional identification, β = .134, 95% BC CI [.028, .237]. The total AI-use association was .099, 95% BC CI [−.007, .199], leaving its overall relationship statistically unresolved. This result is compatible with supported indirect pathways and should not be interpreted as evidence of no possible association.

Although engagement-pathway estimates were numerically larger, contrasts between the two indirect pathways did not establish a difference. Engagement minus motivation yielded .014 for AI use, 95% CI [−.038, .075]; .037 for organizational support, 95% CI [−.010, .089]; and .040 for professional identification, 95% CI [−.018, .106]. The results therefore support retaining both mediators without ranking their strength. Supported indirect associations alongside nonsignificant direct paths describe an indirect-only statistical pattern [65]; they do not demonstrate complete causal mediation.

Table 5 Summary of results for hypotheses H1–H5

Label	**Predictor variable**	**Criterion variable**	**Significance of the association**	**Significance of the association**	**Significance of the association**
Label	Predictor variable	Criterion variable	Direct	Indirect	Total
H1a	Artificial intelligence use	Autonomous work motivation	Yes	–	Yes
H1b	Artificial intelligence use	Work engagement	Yes	–	Yes
H2a	Perceived organizational support	Autonomous work motivation	Yes	–	Yes
H2b	Perceived organizational support	Work engagement	Yes	–	Yes
H3a	Professional identification	Autonomous work motivation	Yes	–	Yes
H3b	Professional identification	Work engagement	Yes	–	Yes
H4a	Autonomous work motivation	Innovative work behavior	Yes	–	Yes
H4b	Work engagement	Innovative work behavior	Yes	–	Yes
H5a–H5b	Artificial intelligence use	Innovative work behavior	No	Yes	No
H5c–H5d	Perceived organizational support	Innovative work behavior	No	Yes	Yes
H5e–	Professional identification	Innovative work	No	Yes	Yes

Label	Predictor variable	Criterion variable	Significance of the association	Significance of the association	Significance of the association
H5f		behavior			

Note. Yes = statistically significant; No = not statistically significant; – = no directed indirect pathway specified. Direct associations use two-sided Wald tests ($p < .05$). Indirect and total associations with innovation use 95% bias-corrected bootstrap intervals. For H1–H4, total associations equal direct associations. Paired H5 labels summarize the two pathways through autonomous work motivation and work engagement; Indirect denotes their sum. Each specific H5 pathway is supported separately (Table 4). Significance does not establish causality.

Discussion

From AI use to innovative practice

AI use was associated with both motivational states, but its total association with innovation did not reach statistical significance in the joint model. One plausible explanation concerns the difference between using a technological resource and reorganizing one's work around an educational purpose. AI may make a task easier or expand the options a teacher can consider; whether that opportunity is experienced as personally worthwhile and energizing depends on the work in which it is embedded. Parker and Grote's [20] work-design perspective makes this distinction consequential: the implications of technology arise through changes in discretion, demands, and the content of work. These conditions were not measured directly here, but they offer an explanation for why a measure of use alone may not capture a consistent innovation advantage.

The outcome also requires more than efficient task completion. Innovative work behavior encompasses developing an idea, obtaining support for it, and putting it into practice [1, 56]. Assistance with producing teaching materials may leave the effort of securing agreement or sustaining implementation largely unchanged. This helps interpret the difference between the present result and the task-performance gains reported by Noy and Zhang [7] and Brynjolfsson et al. [8]. Doshi and Hauser [9] further show that improvements in individual creative output can coexist with reduced diversity across outputs. The present pattern is therefore compatible with useful AI assistance whose broader association with innovative practice depends on teachers' motivational experience. It does not identify which stage of innovation accounts for that pattern.

The statistical distinction between marginal and conditional associations is equally relevant. The total AI-use association estimated here adjusts for organizational support and professional identification; it is not the positive zero-order correlation reported in Table 1. Because the antecedents share variance, their joint estimation asks what each contributes within a broader account of teachers' work. Gai et al. [11] reported a positive direct AI-use relationship in a model emphasizing meaningfulness and creative self-efficacy. Differences in constructs, samples, and adjustment preclude attributing the contrasting direct findings to a single cause. Our contribution is to show that supported motivational pathways can coexist with uncertainty about the conditional total association. The nonsignificant direct estimate does not establish a negative countervailing mechanism or complete mediation.

Support for sustained experimentation

Organizational support was connected with innovation through both autonomous motivation and engagement, and its total association remained positive. A possible explanation is that feeling valued makes uncertain improvement efforts worth undertaking even when their immediate rewards are unclear. Organizational support theory emphasizes the meaning employees attach to favorable treatment and the reciprocal commitments it can invite [27]. The autonomous-motivation pathway adds a different possibility: teachers may endorse improvement because institutional goals have become personally acceptable, rather than acting only from a sense of obligation. This interpretation accords with SDT's account of internalization [28], although the study did not measure need satisfaction or reciprocity and cannot distinguish their contributions.

The engagement pathway concerns the effort needed to continue once an idea encounters practical difficulties. Revising materials, coordinating with colleagues, and trying an unfamiliar practice can require sustained attention without immediate evidence of success. Support may help teachers remain invested in that work, consistent with the resource-based account of engagement in Hakanen et al. [32]. Read alongside Lam et al. [29], who connected supportive school conditions with motivation and persistence intentions, the present result extends the explanatory outcome to reported innovative behavior. It suggests that willing endorsement and energetic involvement each account for part of the support–innovation relationship.

This finding also qualifies an exclusively technology-centered interpretation of innovation. The support measure concerned teachers' general experience of their institution, whereas Moreira-Fontán et al. [10] examined support specifically for innovation. A positive association for broader support suggests that the institutional conditions relevant to innovation may extend beyond dedicated technology initiatives. The result does not identify a particular support practice as effective; it shows that teachers' perceived treatment by their institution retains relevance when AI use and professional identification are considered together.

Professional commitment as a basis for innovation

Professional identification retained associations with both mediators and with subsequent innovation after organizational support was included. This pattern is consistent with improvement efforts drawing on commitments that extend beyond favorable treatment by an employer. When teaching is central to self-definition, revising a practice may become a way to enact professional values. Identification scholarship distinguishes this sense of membership from an evaluation of organizational conditions [34, 37]. That distinction helps explain why professional identification supplied information beyond perceived support in the present model.

The two indirect pathways suggest different ways in which such commitments may be expressed. Professional attachment may make a difficult task worth pursuing, while engagement captures the involvement through which that commitment is sustained in everyday work. Neither follows automatically from belonging to the profession. Their separate associations

with innovation are therefore informative: the contribution of identification was carried through distinguishable motivational experiences rather than being defined as motivation itself. This interpretation complements the broader identity account of Canrinus et al. [38], while preserving the conceptual boundaries between identification, reasons for working, and experienced engagement.

Professional commitment can also encourage scrutiny of a proposed innovation. The contextual accounts of Beijaard et al. [35] and Beauchamp and Thomas [36] leave room for teachers to support, revise, or resist changes according to their professional judgments. Because the present outcome concerned general innovative work behavior, the result should not be read as evidence of uncritical enthusiasm for AI. Its more specific implication is that attachment to teaching may sustain improvement when teachers regard that improvement as professionally worthwhile. The values guiding those judgments remain to be examined.

Why both mediators matter

Autonomous motivation and work engagement each retained a relationship with innovation when the other was included. This is explicable because an endorsed goal and the capacity to remain involved in pursuing it address different demands of innovative work. An unfamiliar practice can be valued without being enjoyable, particularly when implementation involves repetitive revision or negotiation. The autonomous-motivation measure accommodates both intrinsic interest and identified regulation. Its association with innovation is consistent with the importance of motivational quality in Gorozidis and Papaioannou [45], Cerasoli et al. [42], and Van den Broeck et al. [41], but cannot be assigned to either component in isolation.

Engagement offers a complementary explanation for turning intentions into sustained activity. Vigor and dedication may help teachers continue when implementation is slow, while absorption reflects involvement in the task itself. This interpretation connects the present findings with Kwon and Kim's [52] account of innovative behavior and with the performance evidence synthesized by Christian et al. [50]. It also extends the weekly teacher-performance relationships examined by Bakker and Bal [49], although the present estimates concern differences between teachers rather than changes within individuals. The numerically larger engagement pathways do not establish its superiority: the bootstrap contrasts did not distinguish the two indirect associations for any antecedent.

Their shared unexplained variation is also substantively meaningful. Teachers who find their work worth endorsing may often feel engaged in it, while working conditions or response tendencies can influence both experiences. Allowing their disturbances to covary accommodated this overlap without eliminating their separate associations with innovation. Moreira-Fontán et al. [10] placed autonomous motivation before engagement; the present design cannot test that sequence because both were measured on the same occasion. Reciprocal processes identified by Xanthopoulou et al. [54] provide another plausible account. The finding thus supports two distinguishable motivational pathways within a shared work experience, while leaving their temporal interplay open.

Implications for university practice

The findings suggest evaluating AI initiatives through the work they enable teachers to undertake. Training could begin with an educational problem selected by teachers, examine where AI assistance is useful, and require professional evaluation of the proposed solution. This approach is consistent with Nazaretsky et al. [18], who showed the value of explaining AI's complementary role, and with Gagné et al. [46], who foreground self-determination in technological change. The present associations provide a rationale for testing such arrangements rather than evidence that a particular training design will produce innovation.

Institutional support should also address the conditions needed to pursue an idea beyond its initial generation. Time for revision, access to pedagogical advice, and fair consideration of unsuccessful trials are plausible practices to evaluate in light of organizational support and work-design research [20, 27]. Teachers' autonomous motivation and engagement could be monitored separately, since improvement in one does not guarantee improvement in the other. The general support measure used here cannot identify which institutional practice is most effective.

Evaluation should ultimately include the educational merits of implemented changes. More innovative activity is not necessarily better teaching, and greater AI use is not itself a quality criterion. Peer review of teaching materials, evidence of student learning, and teachers' justification of their decisions would complement self-reported innovation. Such evaluation responds to the contextual and ethical concerns raised by Bond et al. [6] while respecting the role of professional judgment suggested by the identification findings.

Limitations

The measurements were ordered in time, but each focal construct was assessed only once. Earlier levels of motivation, engagement, and innovation could not be controlled, and teachers already inclined to innovate may have sought AI tools or experienced their work more favorably. As Cole and Maxwell [66] and Maxwell and Cole [67] show, identifying a longitudinal mediation process requires more than an ordered set of measurements. The approximately four-week intervals establish separation between predictor, mediator, and outcome assessments; they do not establish that the chosen interval captures the development of innovation. Repeated observations of all constructs would permit stronger tests of temporal order and within-person change.

All focal measures were self-reported. Separation across occasions reduces some same-occasion influences but leaves shared response tendencies and self-presentation unresolved [68]. Favorable CFA results do not remove this concern. AI-use records, peer reports, and documented examples of implemented innovations would provide useful complementary evidence. These sources could also distinguish the frequency of innovative activity from its originality, usefulness, and educational consequences.

Measurement choices impose further limits. Autonomous motivation, engagement, and innovative behavior were modeled as broad first-order factors, although their source instruments distinguish components. The referent adaptation of the

identification measure also requires evidence beyond internal consistency and factor loadings. Component-level alternatives, ordinal estimation, and assessment of measurement stability across teacher groups would strengthen subsequent work. General AI use additionally conceals differences in applications, purpose, and discretion, so the present findings cannot be attributed specifically to generative AI or to a particular mode of human–AI collaboration.

The final matched sample does not represent all initial respondents; modestly higher engagement among retained participants may limit generalizability. Unmodeled institutional clustering and background differences may also affect the estimates. Finally, the saturated latent structural portion gives the primary SEM the same global fit as the CFA. Neither its favorable fit nor its supported indirect associations establishes the uniqueness of the proposed explanation. The strongest conclusion is that, within this sample, autonomous motivation and engagement each carry distinct associations linking earlier work experiences with later innovative behavior.

Conclusions

Teachers' innovative work behavior is more clearly understood when technological practice is examined within the experience of professional work. The findings connect institutional support and professional identification with later innovation through both autonomous motivation and engagement, while leaving the overall AI-use association unresolved. They extend an account ending in engagement toward a subsequent behavioral outcome and distinguish the reasons teachers invest in work from the involvement they experience while doing it. For research and practice, the resulting question is how AI use can be situated in conditions that teachers find worth endorsing and are able to sustain as innovative activity.

Abbreviations

AI	Artificial intelligence
SDT	Self-determination theory
JD-R	Job demands–resources theory
SPOS	Survey of Perceived Organizational Support
MWMS	Multidimensional Work Motivation Scale
UWES-9	Utrecht Work Engagement Scale–9
AIU	Artificial intelligence use
POS	Perceived organizational support
PI	Professional identification
AWM	Autonomous work motivation
WE	Work engagement
IWB	Innovative work behavior
CFA	Confirmatory factor analysis

SEM	Structural equation modeling
CR	Composite reliability
AVE	Average variance extracted
HTMT	Heterotrait–monotrait ratio
CFI	Comparative fit index
TLI	Tucker–Lewis index
RMSEA	Root mean square error of approximation
SRMR	Standardized root mean square residual
CI	Confidence interval
SD	Standard deviation
SE	Standard error
T1, T2, T3	Time 1, Time 2, Time 3

Declarations

Ethics approval and consent to participate

This study received ethics approval from the Human Research Ethics Committee of Rattana Bundit University, Thailand. All methods involving human participants were performed in accordance with the ethical standards of the Human Research Ethics Committee of Rattana Bundit University and the ethical principles outlined in the World Medical Association's Declaration of Helsinki (2024 version). Informed consent was obtained from all participants prior to their participation in the study.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare no competing interests.

Funding

This study was supported by the 2025 Guangxi University Research Project on the Theory and Practice of Ideological and Political Education for College Students (grant number: 2025SZ111) and the Key Project of the 2023 Special Program for Higher Education Internationalization under the 14th Five-Year Plan for Guangxi Educational Science (grant number: 2023ZJY1994).

Authors' contributions

The authors confirm contribution to the paper as follows: conceptualization, methodology, formal analysis, investigation, writing—original draft preparation, QX; methodology, supervision, writing—review and editing, PP; study design, data collection, interpretation of the results, writing—review and editing, HL; methodology, interpretation of the findings, supervision, writing—review and editing, YH. All authors read and approved the final manuscript.

Acknowledgements

We sincerely thank all participants in this research for their time and valuable contributions to this study.

References

1. Janssen O. Job demands, perceptions of effort–reward fairness and innovative work behaviour. J Occup Organ Psychol. 2000;73(3):287–302. https://doi.org/10.1348/096317900167038.
2. Anderson N, Potočnik K, Zhou J. Innovation and creativity in organizations: A state-of-the-science review, prospective commentary, and guiding framework. J Manag. 2014;40(5):1297–1333. https://doi.org/10.1177/0149206314527128.
3. Zawacki-Richter O, Marín VI, Bond M, Gouverneur F. Systematic review of research on artificial intelligence applications in higher education—where are the educators? Int J Educ Technol High Educ. 2019;16:39. https://doi.org/10.1186/s41239-019-0171-0.
4. Crompton H, Burke D. Artificial intelligence in higher education: The state of the field. Int J Educ Technol High Educ. 2023;20:22. https://doi.org/10.1186/s41239-023-00392-8.
5. Chiu TKF, Xia Q, Zhou X, Chai CS, Cheng M. Systematic literature review on opportunities, challenges, and future research recommendations of artificial intelligence in education. Comput Educ Artif Intell. 2023;4:100118. https://doi.org/10.1016/j.caeai.2022.100118.
6. Bond M, Khosravi H, De Laat M, Bergdahl N, Negrea V, Oxley E, et al. A meta systematic review of artificial intelligence in higher education: A call for increased ethics, collaboration, and rigour. Int J Educ Technol High Educ. 2024;21:4. https://doi.org/10.1186/s41239-023-00436-z.
7. Noy S, Zhang W. Experimental evidence on the productivity effects of generative artificial intelligence. Science. 2023;381(6654):187–192. https://doi.org/10.1126/science.adh2586.
8. Brynjolfsson E, Li D, Raymond L. Generative AI at work. Q J Econ. 2025;140(2):889–942. https://doi.org/10.1093/qje/qjae044.
9. Doshi AR, Hauser OP. Generative AI enhances individual creativity but reduces the collective diversity of novel content. Sci Adv. 2024;10(28):eadn5290. https://doi.org/10.1126/sciadv.adn5290.
10. Moreira-Fontán E, García-Señorán M, Conde-Rodríguez Á, González A. Teachers' ICT-related self-efficacy, job resources, and positive emotions: Their structural relations with autonomous motivation and work engagement. Comput Educ. 2019;134:63–77. https://doi.org/10.1016/j.compedu.2019.02.007.
11. Gai G, Zhu X, Yang F. How does AI use foster teachers' innovative work behavior? The sequential roles of work meaningfulness and creative self-efficacy. Educ Inf Technol. 2026. Advance online publication. https://doi.org/10.1007/s10639-026-14047-4.
12. Wu X. Teaching with AI, engaging with purpose: University teachers' work engagement in AI-supported higher education. Eur J Educ. 2026;61(3):e70820. https://doi.org/10.1111/ejed.70820.
13. Deci EL, Ryan RM. The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. Psychol Inq. 2000;11(4):227–268. https://doi.org/10.1207/S15327965PLI1104_01.

14. Bakker AB, Demerouti E. Job demands–resources theory: Taking stock and looking forward. J Occup Health Psychol. 2017;22(3):273–285. https://doi.org/10.1037/ocp0000056.
15. Gagné M, Deci EL. Self-determination theory and work motivation. J Organ Behav. 2005;26(4):331–362. https://doi.org/10.1002/job.322.
16. Kasneci E, Sessler K, Küchemann S, Bannert M, Dementieva D, Fischer F, et al. ChatGPT for good? On opportunities and challenges of large language models for education. Learn Individ Differ. 2023;103:102274. https://doi.org/10.1016/j.lindif.2023.102274.
17. Glikson E, Woolley AW. Human trust in artificial intelligence: Review of empirical research. Acad Manag Ann. 2020;14(2):627–660. https://doi.org/10.5465/annals.2018.0057.
18. Nazaretsky T, Ariely M, Cukurova M, Alexandron G. Teachers' trust in AI-powered educational technology and a professional development program to improve it. Br J Educ Technol. 2022;53(4):914–931. https://doi.org/10.1111/bjet.13232.
19. Raisch S, Krakowski S. Artificial intelligence and management: The automation–augmentation paradox. Acad Manag Rev. 2021;46(1):192–210. https://doi.org/10.5465/amr.2018.0072.
20. Parker SK, Grote G. Automation, algorithms, and beyond: Why work design matters more than ever in a digital world. Appl Psychol. 2022;71(4):1171–1204. https://doi.org/10.1111/apps.12241.
21. Tang PM, Koopman J, McClean ST, Zhang JH, Li CH, De Cremer D, et al. When conscientious employees meet intelligent machines: An integrative approach inspired by complementarity theory and role theory. Acad Manag J. 2022;65(3):1019–1054. https://doi.org/10.5465/amj.2020.1516.
22. He G, Zheng X, Li W, Tan L, Chen S, He Y. The mixed blessing of leaders' artificial intelligence (AI)-oriented change behavior: Implications for employee job performance and unethical behavior. Appl Res Qual Life. 2024;19:469–497. https://doi.org/10.1007/s11482-023-10250-4.
23. Bakker AB, Demerouti E, Sanz-Vergel A. Job demands–resources theory: Ten years later. Annu Rev Organ Psychol Organ Behav. 2023;10:25–53. https://doi.org/10.1146/annurev-orgpsych-120920-053933.
24. Eisenberger R, Huntington R, Hutchison S, Sowa D. Perceived organizational support. J Appl Psychol. 1986;71(3):500–507. https://doi.org/10.1037/0021-9010.71.3.500.
25. Rhoades L, Eisenberger R. Perceived organizational support: A review of the literature. J Appl Psychol. 2002;87(4):698–714. https://doi.org/10.1037/0021-9010.87.4.698.
26. Kurtessis JN, Eisenberger R, Ford MT, Buffardi LC, Stewart KA, Adis CS. Perceived organizational support: A meta-analytic evaluation of organizational support theory. J Manag. 2017;43(6):1854–1884. https://doi.org/10.1177/0149206315575554.
27. Eisenberger R, Rhoades Shanock L, Wen X. Perceived organizational support: Why caring about employees counts. Annu Rev Organ Psychol Organ Behav. 2020;7:101–124. https://doi.org/10.1146/annurev-orgpsych-012119-044917.
28. Deci EL, Olafsen AH, Ryan RM. Self-determination theory in work organizations: The state of a science. Annu Rev Organ Psychol Organ Behav. 2017;4:19–43. https://doi.org/10.1146/annurev-orgpsych-032516-113108.
29. Lam SF, Cheng RWY, Choy HC. School support and teacher motivation to implement project-based learning. Learn Instr. 2010;20(6):487–497. https://doi.org/10.1016/j.learninstruc.2009.07.003.
30. Saks AM. Antecedents and consequences of employee engagement. J Manag Psychol. 2006;21(7):600–619. https://doi.org/10.1108/02683940610690169.
31. Rich BL, LePine JA, Crawford ER. Job engagement: Antecedents and effects on job performance. Acad Manag J. 2010;53(3):617–635. https://doi.org/10.5465/amj.2010.51468988.

32. Hakanen JJ, Bakker AB, Schaufeli WB. Burnout and work engagement among teachers. J Sch Psychol. 2006;43(6):495–513. https://doi.org/10.1016/j.jsp.2005.11.001.
33. Mael F, Ashforth BE. Alumni and their alma mater: A partial test of the reformulated model of organizational identification. J Organ Behav. 1992;13(2):103–123. https://doi.org/10.1002/job.4030130202.
34. Ashforth BE, Harrison SH, Corley KG. Identification in organizations: An examination of four fundamental questions. J Manag. 2008;34(3):325–374. https://doi.org/10.1177/0149206308316059.
35. Beijaard D, Meijer PC, Verloop N. Reconsidering research on teachers' professional identity. Teaching and Teacher Education. 2004;20(2):107–128. https://doi.org/10.1016/j.tate.2003.07.001.
36. Beauchamp C, Thomas L. Understanding teacher identity: An overview of issues in the literature and implications for teacher education. Camb J Educ. 2009;39(2):175–189. https://doi.org/10.1080/03057640902902252.
37. van Dick R, Wagner U. Social identification among school teachers: Dimensions, foci, and correlates. Eur J Work Organ Psychol. 2002;11(2):129–149. https://doi.org/10.1080/13594320143000889.
38. Canrinus ET, Helms-Lorenz M, Beijaard D, Buitink J, Hofman A. Self-efficacy, job satisfaction, motivation and commitment: Exploring the relationships between indicators of teachers' professional identity. Eur J Psychol Educ. 2012;27(1):115–132. https://doi.org/10.1007/s10212-011-0069-2.
39. Ryan RM, Deci EL. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. Am Psychol. 2000;55(1):68–78. https://doi.org/10.1037/0003-066X.55.1.68.
40. Gagné M, Forest J, Vansteenkiste M, Crevier-Braud L, Van den Broeck A, Aspeli AK, et al. The Multidimensional Work Motivation Scale: Validation evidence in seven languages and nine countries. Eur J Work Organ Psychol. 2015;24(2):178–196. https://doi.org/10.1080/1359432X.2013.877892.
41. Van den Broeck A, Howard JL, Van Vaerenbergh Y, Leroy H, Gagné M. Beyond intrinsic and extrinsic motivation: A meta-analysis on self-determination theory's multidimensional conceptualization of work motivation. Organ Psychol Rev. 2021;11(3):240–273. https://doi.org/10.1177/20413866211006173.
42. Cerasoli CP, Nicklin JM, Ford MT. Intrinsic motivation and extrinsic incentives jointly predict performance: A 40-year meta-analysis. Psychol Bull. 2014;140(4):980–1008. https://doi.org/10.1037/a0035661.
43. Fernet C, Senécal C, Guay F, Marsh H, Dowson M. The Work Tasks Motivation Scale for Teachers (WTMST). J Career Assess. 2008;16(2):256–279. https://doi.org/10.1177/1069072707305764.
44. Fernet C, Trépanier SG, Austin S, Gagné M, Forest J. Transformational leadership and optimal functioning at work: On the mediating role of employees' perceived job characteristics and motivation. Work Stress. 2015;29(1):11–31. https://doi.org/10.1080/02678373.2014.1003998.
45. Gorozidis G, Papaioannou AG. Teachers' motivation to participate in training and to implement innovations. Teaching and Teacher Education. 2014;39:1–11. https://doi.org/10.1016/j.tate.2013.12.001.
46. Gagné M, Parker SK, Griffin MA, Dunlop PD, Knight C, Klonek FE, et al. Understanding and shaping the future of work with self-determination theory. Nat Rev Psychol. 2022;1:378–392. https://doi.org/10.1038/s44159-022-00056-w.
47. Schaufeli WB, Salanova M, González-Romá V, Bakker AB. The measurement of engagement and burnout: A two sample confirmatory factor analytic approach. J Happiness Stud. 2002;3(1):71–92. https://doi.org/10.1023/A:1015630930326.
48. Schaufeli WB, Bakker AB, Salanova M. The measurement of work engagement with a short questionnaire: A cross-national study. Educ Psychol Meas. 2006;66(4):701–716. https://doi.org/10.1177/0013164405282471.
49. Bakker AB, Bal MP. Weekly work engagement and performance: A study among starting teachers. J Occup Organ Psychol. 2010;83(1):189–206. https://doi.org/10.1348/096317909X402596.

50. Christian MS, Garza AS, Slaughter JE. Work engagement: A quantitative review and test of its relations with task and contextual performance. Pers Psychol. 2011;64(1):89–136. https://doi.org/10.1111/j.1744-6570.2010.01203.x.
51. Hakanen JJ, Perhoniemi R, Toppinen-Tanner S. Positive gain spirals at work: From job resources to work engagement, personal initiative and work-unit innovativeness. J Vocat Behav. 2008;73(1):78–91. https://doi.org/10.1016/j.jvb.2008.01.003.
52. Kwon K, Kim T. An integrative literature review of employee engagement and innovative behavior: Revisiting the JD-R model. Hum Resour Manag Rev. 2020;30(2):100704. https://doi.org/10.1016/j.hrmr.2019.100704.
53. Gupta RK, Sikarwar E. Ethical leadership and innovative work behavior: A signaling perspective on personal engagement and task significance. Int J Hosp Manag. 2026;139:104772. https://doi.org/10.1016/j.ijhm.2026.104772.
54. Xanthopoulou D, Bakker AB, Demerouti E, Schaufeli WB. Reciprocal relationships between job resources, personal resources, and work engagement. J Vocat Behav. 2009;74(3):235–244. https://doi.org/10.1016/j.jvb.2008.11.003.
55. Scott SG, Bruce RA. Determinants of innovative behavior: A path model of individual innovation in the workplace. Acad Manag J. 1994;37(3):580–607. https://doi.org/10.5465/256701.
56. De Jong J, Den Hartog D. Measuring innovative work behaviour. Creat Innov Manag. 2010;19(1):23–36. https://doi.org/10.1111/j.1467-8691.2010.00547.x.
57. Hammond MM, Neff NL, Farr JL, Schwall AR, Zhao X. Predictors of individual-level innovation at work: A meta-analysis. Psychol Aesthet Creat Arts. 2011;5(1):90–105. https://doi.org/10.1037/a0018556.
58. Thurlings M, Evers AT, Vermeulen M. Toward a model of explaining teachers' innovative behavior: A literature review. Rev Educ Res. 2015;85(3):430–471. https://doi.org/10.3102/0034654314557949.
59. Eisenberger R, Stinglhamber F, Vandenberghe C, Sucharski IL, Rhoades L. Perceived supervisor support: Contributions to perceived organizational support and employee retention. J Appl Psychol. 2002;87(3):565–573. https://doi.org/10.1037/0021-9010.87.3.565.
60. Anderson JC, Gerbing DW. Structural equation modeling in practice: A review and recommended two-step approach. Psychol Bull. 1988;103(3):411–423. https://doi.org/10.1037/0033-2909.103.3.411.
61. Fornell C, Larcker DF. Evaluating structural equation models with unobservable variables and measurement error. J Mark Res. 1981;18(1):39–50. https://doi.org/10.1177/002224378101800104.
62. Henseler J, Ringle CM, Sarstedt M. A new criterion for assessing discriminant validity in variance-based structural equation modeling. J Acad Mark Sci. 2015;43:115–135. https://doi.org/10.1007/s11747-014-0403-8.
63. Hu LT, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. Struct Equ Modeling. 1999;6(1):1–55. https://doi.org/10.1080/10705519909540118.
64. Preacher KJ, Hayes AF. Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behav Res Methods. 2008;40(3):879–891. https://doi.org/10.3758/BRM.40.3.879.
65. Zhao X, Lynch JG Jr, Chen Q. Reconsidering Baron and Kenny: Myths and truths about mediation analysis. J Consum Res. 2010;37(2):197–206. https://doi.org/10.1086/651257.
66. Cole DA, Maxwell SE. Testing mediational models with longitudinal data: Questions and tips in the use of structural equation modeling. J Abnorm Psychol. 2003;112(4):558–577. https://doi.org/10.1037/0021-843X.112.4.558.
67. Maxwell SE, Cole DA. Bias in cross-sectional analyses of longitudinal mediation. Psychol Methods. 2007;12(1):23–44. https://doi.org/10.1037/1082-989X.12.1.23.
68. Podsakoff PM, MacKenzie SB, Lee JY, Podsakoff NP. Common method biases in behavioral research: A critical review of the literature and recommended remedies. J Appl Psychol. 2003;88(5):879–903. https://doi.org/10.1037/0021-9010.88.5.879.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Supplementary1T1BilingualQuestionnaire.docx
- Supplementary2T2BilingualQuestionnaire.docx
- Supplementary3T3BilingualQuestionnaire.docx